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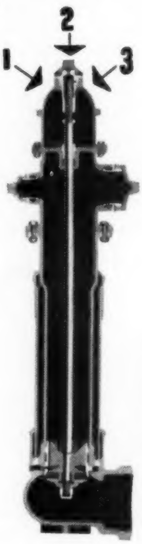
AMERICAN WATER WORKS ASSOCIATION

In this issue



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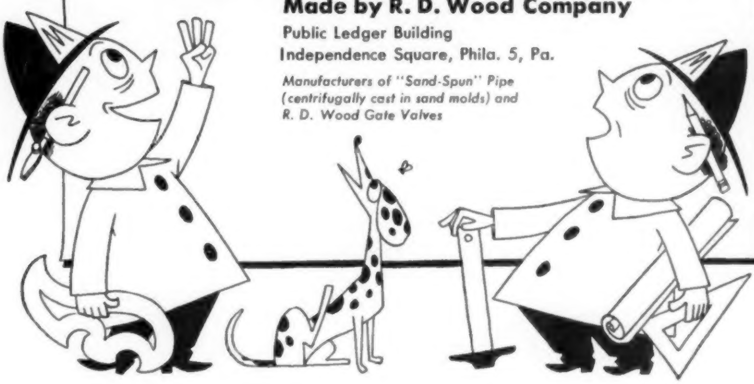

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COMING MEETINGS

June 29—New Jersey Section Summer Meeting (inspection trip and luncheon), Trenton, N.J. Secretary, C. B. Tygert, Box 178, Newark 1, N.J.

September **12–14**—Minnesota Section at Hotel Nicollet, Minneapolis. Secretary: Leonard N. Thompson, Gen. Mgr., Water Dept., St. Paul 2, Minn.

13–14—New York Section at Whiteface Inn, Whiteface. Secretary: R. K. Blanchard, Vice Pres., Neptune Meter Co., 50 W. 50th St., New York, N.Y.

17–19—Kentucky-Tennessee Section at Louisville Kentucky Hotel, Louisville. Secretary: R. P. Farrell, Director, Div. of San. Eng., State Dept. of Public Health, 420—6th Ave., N., Nashville, Tenn.

19–21—Michigan Section at Whitcomb Hotel, St. Joseph. Secretary: T. L. Vander Velde, Chief, Section of Water Supply, State Dept. of Health, Lansing 4, Mich.

19–21—Pennsylvania Section at Bellevue-Stratford Hotel, Philadelphia. Secretary: L. S. Morgan, Div. Engr., State Dept. of Health, Greensburg, Pa.

24–25—Rocky Mountain Section at Hotel Cosmopolitan, Denver, Colo. Secretary: George J. Turre, San. Engr., Board of Water Comrs., Box 600, Denver, Colo.

24–26—Alabama-Mississippi Section at Buena Vista Hotel, Biloxi, Miss. Secretary: Charles W. White, Asst. San. Engr., State Dept. of Public Health, 537 Dexter Ave., Montgomery 4, Ala.

25–27—Wisconsin Section at Pfister Hotel, Milwaukee. Secretary: Leon A. Smith, Supt., Water & Sewerage, City Hall, Madison 3, Wis.

27–28—Ohio Section at Commodore Perry Hotel, Toledo. Secretary: F. P. Fischer, Sales Engr., Wallace & Tiernan Co., 812 Perry Payne Bldg., Cleveland 13, Ohio.

Sept. 30–October 2—Missouri Section at Hotel Robidoux, St. Joseph. Secretary: Warren A. Kramer, Div. of Health, State Office Bldg., Jefferson City, Mo.

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[illegible] PER UNIT, M.G.D.	1.5	1.0	3.1	10.0	3.0
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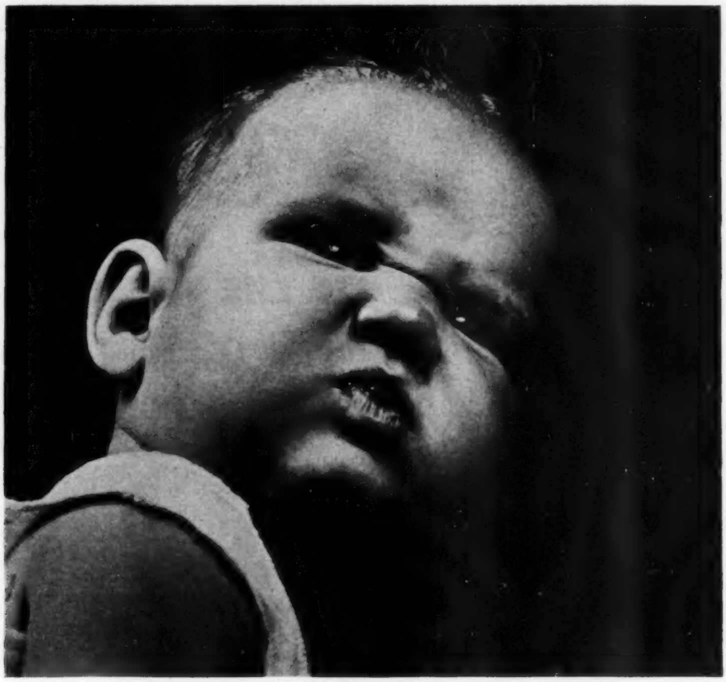

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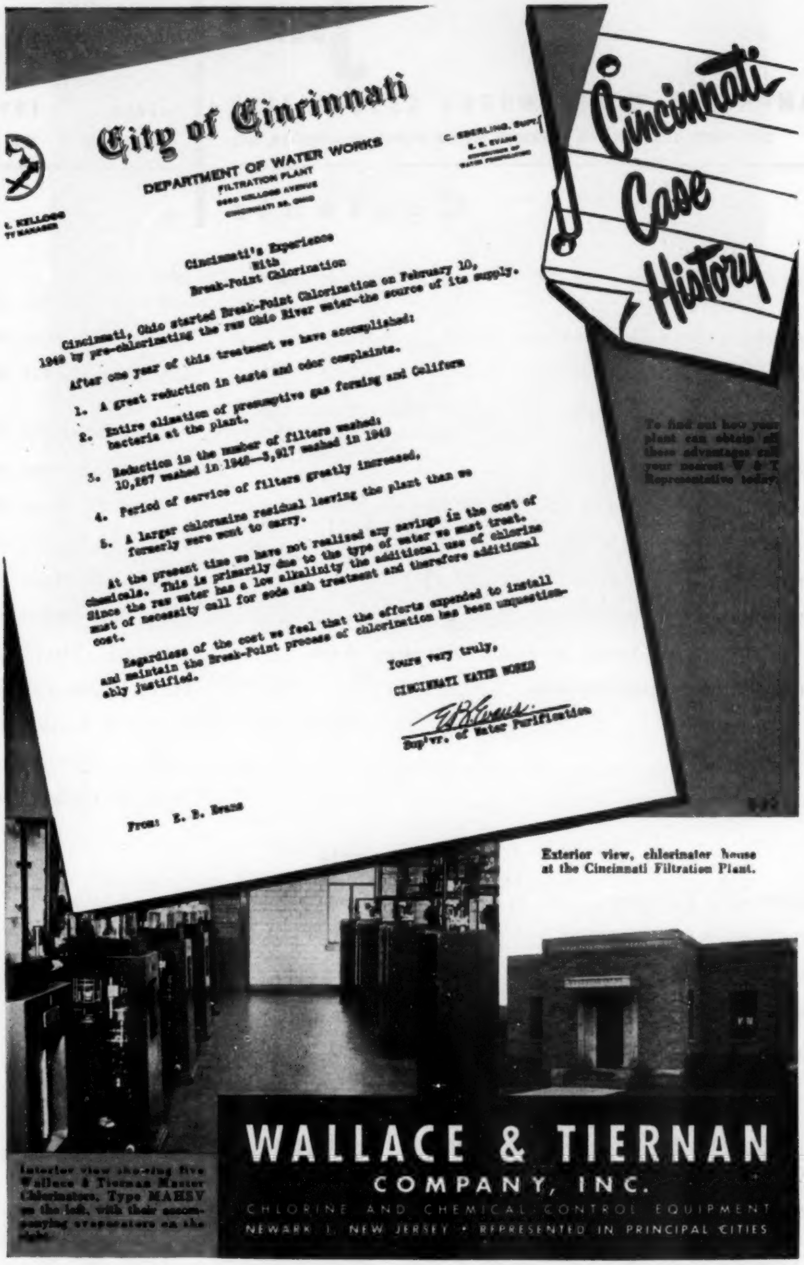
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Journal

AMERICAN WATER WORKS ASSOCIATION

VOL. 43 • JUNE 1951 • NO. 6

Review of the Report of the President's Water Resources Policy Commission

By Samuel B. Morris

A paper presented on May 2, 1951, at the Annual Conference, Miami, by Samuel B. Morris, Gen. Mgr. & Chief Engr., Dept. of Water & Power, Los Angeles, Calif.

WATER for domestic purposes fills the most fundamental of all water needs. An adequate quantity and quality of water for domestic purposes is an absolute requisite to the towns and cities, the farms and rural areas of the nation. Water is required for the support of life, for cleanliness, for comfort and for the removal of human and industrial wastes. Many industries require water in large quantities for industrial processes and for cooling.

This discussion, however, will not consider the water problem solely from the standpoint of domestic or industrial use. The only proper way to appraise the availability and the most economic development of the nation's water resources is to consider an entire river and drainage area, and all needs for water and related land uses in that area.

Water falls on the forests and pasture lands of mountainous areas, and on the hills and valleys, running off the land to the streams and rivers. Rainfall and runoff cause some erosion. It has been so throughout geologic time. The physiography of the country as we see and know it is largely the result of the erosion of the high lands and the filling in of the fertile valleys. Forest growth, pasture land, and farm land affect the quantity, distribution and quality of the water which enters the soil or runs off to the rivers for later use by man.

Constructing works on a river, diverting water to cities and to industries, or turning it on to lands—with the subsequent return of much of this water to the river—affects not only the river itself but the economy, health and welfare of the entire population within the drainage area and adjacent to the river. The river thus has a vital effect upon the people and the economy within the basin in much the same

manner that the blood supply and vascular system affect the activities of the human body and maintain life itself.

The impact of the problems resulting from the interdependence of water and related land uses on the river systems and drainage basins of the United States is now recognized as being of deep concern to the nation. The problems are fundamental, and, upon their proper solution, and the proper management of our water resources, millions of Americans of the future must depend for actual survival.

To give the broadest consideration to these problems, Mr. Truman in January 1950 appointed the President's Water Resources Policy Commission. The commission's studies, conducted over a period of a year, have sought to appraise the uses to which our land and water resources have been put, and, with consideration for the present and future needs of the nation, to make recommendations for a national policy to guide the government's actions.

It may be helpful first to review the situation for the nation as a whole. Upon the area of the continental United States—about 1,935 million acres—falls an annual average of 30 in. of precipitation. Of this amount, 21 in. is lost to the atmosphere by evaporation and transpiration. The remainder—about 9 in., averaging 1,300,000 mgd.—runs off to the sea. Approximately one-third of the runoff penetrates the soil to appear again in the form of ground water.

Domestic uses account for about 1 per cent of the available water supply. All uses, including those of industry and irrigation, take about 10 per cent of the average annual runoff, as nearly as is known.

Unfortunately, there is no national agency which collects and publishes all data on use and consumption of water, in the manner that the Federal Power Commission, for example, accounts for the total capacity and sales of power for various uses. It is something of a paradox that electricity, that rather mysterious form of energy which cannot be seen, can be measured more accurately and be more fully accounted for than the very tangible substance, water.

To speak of average annual rainfall or runoff, however, is to overlook the important factors of inequalities in distribution from area to area, and the great variations which occur from season to season, year to year, or over long cycles of years. Much of the United States west of the 97th meridian, constituting the 17 western states, receives not 30 but less than 20 in. of rainfall. West of the Rockies, there are generally six months of summer with almost no rainfall, requiring the irrigation of crops. Some areas of the Far West have more than 100 in. of rainfall, still others have less than 5; some have 100 in. of runoff, some have none. Problems of storage, regulation and long distance transportation of water from areas of surplus to areas of need are usual not only in the arid West but frequently in the humid East, particularly where there are large concentrations of population in cities and metropolitan areas.

Natural Resources

In the rapid growth of our nation, we have been profligate with its natural resources. Timber, gas, oil, fertile topsoil, iron, copper and other metals and minerals have been exploited with all too little thought of conservation.

Water, land and air are the continuously renewable resources required by all animal and vegetable life. The con-

tinuing increase in the nation's population has resulted in an ever-increasing need for these natural resources. War and national defense preparations stimulate increased requirements and demands. It is not untimely, therefore, for the nation to give renewed interest and consideration to its water and related land uses.

The efficiency of the private enterprise system has enabled our nation to lead the world in production. It is the province of government, however, to provide the plans and means for making certain that water and land will be continuously available. These basic resources will be needed to provide adequate forests for timber, grazing lands for cattle and sheep and fertile soils for food and fiber production to supply ever-increasing populations and, it is hoped, for ever-increasing standards of living. During a national emergency this responsibility is greatly increased. The nation must be made strong enough to resist enemy attack and, if necessary, to wage war. To produce, private enterprise must have these fundamental natural resources in abundance and at reasonable cost.

At the present time, the country is actively engaged in increasing its armament. The pressure to make the best use of time, materials and financing to advance the defense effort will undoubtedly reduce the immediate construction budget for federal water projects. But this same period should give water supply planners the "creative pause" they need for collection of more adequate data, and for more thorough planning and consideration of water and land use policies for projects best designed to meet the new situation of expanding population and industries, which may be expected in the immediate decades to come.

Projects

The development of the nation's water and land use policies began as a series of individual projects: for domestic water supply, for irrigation, for land drainage, for navigation, for flood control, for hydroelectric power, for timber, grazing and crop production, for soil conservation, and for stream pollution control. These developments have been the work of individuals, corporations, municipalities and other local governments, and the federal government. Frequently dual-purpose projects resulted, such as domestic water supply with incidental power development. Projects of this kind were constructed by San Francisco and Los Angeles with their great aqueducts conveying water from the high Sierras and producing power through aqueduct hydroelectric plants. Many irrigation projects have also provided for incidental power development and many flood control and navigation projects have similarly served a dual purpose.

The Boulder Canyon Project was the first great multipurpose water resource development which combined most of these objectives into a single program. Construction of this project —of which the Hoover Dam is the major structure—began only twenty years ago. The dam stores nearly two years' flow of the Colorado River, providing flood control and silt control for the irrigated lands adjacent to the lower river. It provides irrigation for a million acres of land, and hydroelectric power of more than 1 million kw., with an annual average of about 5 billion kw.-hr. The Colorado River aqueduct, built by the Metropolitan Water District of Southern California, brings water to 32 cities between Los Angeles and San Diego with an aggregate population of more than 3½ million. Al-

though at present only 20 per cent of the capacity of this aqueduct is being used, the full capacity of 1,000 mgd. will ultimately provide water for more than 5 million people. This supply, added to local water supplies and waters imported from the Sierras, will provide for a population of not less than 8 million on the coastal plain of Southern California. The Boulder Canyon water project, built by the federal Bureau of Reclamation, and being paid for in full by water and power users of the area served, is still one of the best examples of multipurpose water developments.

Multipurpose Projects

Beginning in the early 1930's and stimulated by the depression, a large number of multipurpose water projects were conceived, designed and begun or constructed by the federal government. These included such noted developments as Bonneville, Grand Coulee, McNary and Chief Joseph Dams on the Columbia River, and Fort Peck and the many dams under construction on the Missouri River. These projects have been divided between the Bureau of Reclamation and the Corps of Engineers as constructing agencies. The Tennessee Valley Authority, and the conception, planning and management of its coordinated river development, have developed the Tennessee River into a truly great enterprise, in which nearly a billion dollars have been spent for flood control, navigation, hydroelectric power and improved land-use practices.

The basic laws under which the several federal agencies operate are dissimilar and have been fundamentally drafted to govern single-purpose rather than multipurpose projects. The fiscal requirements for authorization and repayment have varied greatly under federal authorizations depending, in part, upon the construction agency selected. In general, domestic and industrial water projects and hydroelectric projects have met their full costs, with interest, in 40 to 50 years; several domestic water projects have been authorized, however, which are to repay their capital cost in 40 years without payment of interest.

The Reclamation Law of 1902, with its many amendments, now provides that projects may be authorized if the cost allocated to irrigation is returned without interest in 40 years, plus a 10-year development period. In general, low-cost irrigation projects able to meet these standards cannot now be found. To meet increased costs beyond the ability of the irrigator to pay, the general taxpayer has been called upon to subsidize such projects, largely by forgoing the so-called interest component and applying it to the retirement of the irrigation capital, by increasing power rates and by other means. Many bills which provided for specific projects also provided for longer periods of repayment without interest—sometimes as long as 75 years or more. Although the opportunities for improving the land through drainage are comparable to those of irrigation, little has been done in this field by the national government. Land drainage has largely been accomplished by local districts.

Flood Control

Prior to 1936—when the first flood control act was adopted—the federal government participated in flood control only on the lower Mississippi River, the Sacramento River, and Lake Okechobee in Florida. With the adoption of that act, the federal government was required to carry the entire cost of flood control construction, provided

that local agencies procured the rights-of-way, agreed to operate the works and relieved the government of any liability for damages. Only two years later, in 1938, the act was amended so that, under certain conditions in flood control storage projects, the federal government would carry the entire costs without any local assessment or contributions.

Improvement of navigation, the preservation of fish and wildlife, and provision for public recreation have also received government consideration in the planning and development of water projects. Navigation of inland waterways has been supported by the federal government since 1824, and the improved waterways are free from toll. Under an amendment to the Reclamation Law, federal expenditures for fish and wildlife have been declared nonreimbursable. Efforts have also been made to declare expenditures for recreational facilities, silt control, general salinity control, transportation and national defense as nonreimbursable, but no general act has yet made such provisions. In a number of special acts authorizing particular projects, recreation has been included as a nonreimbursable expenditure.

The dense industrialized population of such areas as the Ohio River Valley, where almost 50 per cent of the total volume of the river at low flow has passed through industrial processes or sewers, has intensified the problems of stream pollution control. The 1948 Water Pollution Control Act declares it congressional policy to recognize the primary responsibilities and rights of the states in controlling water pollution. A program of financial assistance by the federal government, however, provides loans to local government agencies at low rates of interest, and allocates funds to the states for investigations, research and studies on the control of water pollution caused by industrial wastes.

Scope of Commission Activities

Confronted with these conflicting and piecemeal provisions for water development, the President's Water Resources Policy Commission began its work early in 1950. President Truman named seven men to serve on this commission. Morris L. Cooke, consulting engineer of Philadelphia was appointed Chairman. Others appointed to the commission were Paul S. Burgess, Dean, College of Agriculture, University of Arizona, a biochemist; Lewis Webster Jones, President, University of Arkansas, an economist; Leland Olds, former member of the Federal Power Commission; Roland R. Renne, President of Montana State College, a land economist; Gilbert F. White, President of Haverford College, a geographer; and Samuel B. Morris, General Manager, Los Angeles Department of Water and Power, an engineer.

The commission was asked to make recommendations for a comprehensive policy of water resources and related land use development, giving particular consideration to:

1. The extent and character of federal government participation in major water resources programs
2. An appraisal of the water resources priority program from the standpoint of economic and social needs
3. Criteria and standards for evaluating the feasibility of such projects
4. Desirable legislation or changes in existing legislation.

The commission met in Washington in January 1950 and organized a staff of about 50—largely gathered from federal departments and bureaus and universities—into a series of commit-

tees in each major field of inquiry, such as basic data, coordination of planning and projects, water resources policies involving land use, and economics of inland water navigation. One committee was to evaluate selected water resources projects already constructed, recording experiences of the success or failure of such projects as guides to future project selection. One of the very important committees was on water law. The chairman of almost every committee was a staff member of the commission.

At its first meeting the commission decided to open its discussions to every available angle of public and private opinion. The commission sought to secure technical, economic and social information from a variety of sources. Questionnaires were sent to the faculties of many colleges and universities, to each of the 48 governors, to departments and bureaus of the federal government, to engineering, economic and scientific societies.

Eight field conferences were held in widely separated areas: Sioux City, Iowa; Spokane, Wash.; Berkeley, Calif.; Denver, Colo.; Fayetteville, Ark.; Columbus, Ohio; Springfield, Mass.; and Atlanta, Ga. More than 2,000 people attended the regional conferences and 500 individuals commented on various phases of water resources development programs and policies.

Before recommending a course of action for dealing with the country's water resources, the commission studied the needs of selected regions, and sought to determine the possible effects of proposed policies upon those regions and the communities within them. This was done by studying ten river basins, selected for their diversity of size, hydrology, economic needs and water development possibilities. The basins selected were the Columbia, Central Valley of California, Colorado, Rio Grande, Missouri, Ohio, Tennessee, Alabama-Coosa, Potomac and Connecticut. For each of these basins, representing all the major sections of the United States, the interested federal agencies were asked to pool their information and experience in defining the problems and in suggesting programs which might be expected to contribute most to their development. In these cooperative appraisals the commission brought all of the accumulated findings to bear, including hundreds of state and federal surveys. From these have come a series of ten portraits which are printed in the second volume of the commission's report.

The first volume of the report, comprising 445 pages, was filed December 1, 1950 under the title, *A Water Policy for the American People*. A summary of recommendations in the form of a 24-page pamphlet was released with the first volume on December 17. Volume 2, *Ten Rivers in America's Future,* comprising 801 pages, and Volume 3, *Water Resources Law,* 777 pages, were both released during February 1951. The commission has completed its work, including the draft of a proposed Water Resources Act which has not yet been released. The commission considers itself discharged.

Recommendations

The Water Resources Policy Commission early came to the conclusion that the river basin should be the fundamental unit for comprehensive planning of water and related land uses. It recommended that a uniform policy be applied to all water and land use development regardless of which federal

agency might have jurisdiction. This procedure, of course, would be simplified if the recommendations of the Hoover Commission were adopted. It will be recalled that the Hoover Commission's task force recommended that a new natural resources department be formed and that all water resource agencies be placed in the new department under an administrator of cabinet status. The Hoover Commission itself simply recommended that all federal water resource agencies be placed in the Department of the Interior.

Organization and Procedure

President Truman's instructions to the Water Resources Policy Commission asked that it confine its studies and recommendations to matters of policy, leaving out organization, which the Hoover committee had studied. The Water Resources Policy Commission did find it necessary, however, to make some organizational recommendations without necessarily requiring changes in the existing structure of federal agencies charged with water resources development. One recommendation calls for the creation of river basin commissions composed of representatives of the states and federal agencies involved, under the guidance of an independent chairman appointed by the President. The commissions would be responsible for securing federal, state and local cooperation in comprehensive plans for the best utilization of the water and land resources of each river basin, and would coordinate the work of all federal agencies operating in the basins.

Another recommendation proposes a federal board of review which would coordinate the functions of the river basin commissions, prescribe uniform standards of evaluation, authorization and reimbursement, and assure the carrying out of a single, uniform national water resources policy. The board of review would study and evaluate all requests for authorization of surveys, plans, projects or programs before they were submitted to the President for transmission to the Congress. Projects would only be authorized by acts of Congress.

Each river basin commission would prepare estimates of the cost and anticipated benefits, both direct and indirect, of projects. In addition to a statement of all monetary costs and benefits, each commission would describe such other costs, detriments and benefits as are not subject to monetary evaluation for transmission to the board of review.

The board would submit annual reports consolidating basin committee requests. It would continually survey all federal legislation and functions affecting water resources development, with a view toward seeking legislative changes to eliminate conflicts and inconsistencies and improve the nation's water and land resources continuously.

Another recommendation calls for a standard, uniform system of accounting which would show—at the project level, the river basin level and the national level—the capital, operation and maintenance costs, and their allocations to each of the various uses, such as irrigation, domestic water supply, power and flood control. All capital, operation and maintenance, and interest costs would thus be shown clearly by projects, and would also be aggregated by basins. The recommendation emphasizes financial accountability and stresses local and state participation not only in the planning and administration of projects but in contributions toward their cost.

Repayment of Project Costs

The Water Resources Policy Commission recommends that certain principles govern repayment on new water resources projects.

Domestic and industrial water supply. If works supplying water for domestic and industrial use—essentially a matter of local concern and responsibility—are constructed by the United States, the beneficiaries should repay the entire allocation of cost to these uses within 50 years, with interest equal to that paid by the federal government on long-term loans.

Power. Beneficiaries of power projects should repay their full cost, with interest, in 50 years. The policy should be the same for domestic and industrial water supply.

Reclamation. Reclamation by either irrigation or drainage should be on an equal basis, and the beneficiaries should repay the United States—without interest and within their maximum ability to pay—the cost allocated to irrigation or drainage. The benefited states and local areas should reimburse the federal government through the organization of conservation districts or through other means by which states and local agencies may share in the cost of irrigation development and flood control.

Flood Control. The present policy under which the federal government carries all flood control costs is not endorsed. The cost of flood control should be borne in part by the states and local governments, through the formation of flood control and conservation districts, and payments should be made to the United States without interest, within their ability to pay, as for reclamation.

Navigation. The federal government should not improve the navigability of rivers merely to reduce railroad rates. The commission believes that, as important additions to transportation facilities, waterways should be built and improved if such action is economically desirable. If waterways can properly carry their costs and haul goods at lower rates than the railroads, they should do so. Railroad rates should not be lowered on rail lines paralleling waterways and increased on rail lines which do not parallel waterways. If and when water and rail transportation rates can be fixed, the commission believes that on a cost basis, tolls should be charged on inland waterways, in order that water traffic may bear its just portion of the cost of river projects allocated to the improvement of navigation.

Recreation, Fish and Wildlife. Multipurpose water projects providing, in part, for recreation, fish and wildlife should have their capital allocations to these fields met out of general government taxes, except to the extent that revenues are derived from fees and charges. An exception also seems justified if recreational facilities are primarily of local significance; such costs should be borne by the local interests benefiting.

Stream Pollution Control. The 1948 pollution control law should be continued, maintaining pollution control as a responsibility of state and local government. The federal government should loan money at a low rate of interest to permit both state and local governments and industry to mitigate pollution problems, and the federal government should lead in scientific and technical investigations to determine improved methods of pollution control, particularly against industrial contamination. After ten years a reexamination should be made to determine the effectiveness of the 1948 pollution control law.

The Water Resources Policy Commission has made no estimate of the probable cost of the nationwide coordinated programs which it recommends. Table 1, however, gives the costs involved by the water resources plans and proposals of existing federal agencies as they were reported to the Senate in 1948. Allowance must be made for subsequent increases in cost.

Agricultural Policies

Many questions are asked about agricultural surpluses and the heavy drains on the federal treasury for support of agricultural prices, which run into billions of dollars. The commission is in full agreement that the program for bringing new lands under cultivation should be geared to the necessities of agricultural production. At present, there are 375 million acres of crop land and over 600 million acres of forest land, of which 350 million acres are grazed. The total area grazed is 1,052 million acres. It requires several acres of grazing land to produce the equivalent of an acre of crop land. The Department of Agriculture estimates the present total agricultural and grazing land as equivalent to 542 million acres of crop land.

TABLE 1

*Capital Cost of Federal Water Resources Projects**

	billions
Completed to date	$ 5
Under construction	5
Planned and available for authorizations	20
Proposed at a later date	30
TOTAL	$60

* Taken from 1948 report to the Senate.

The acreage required to provide feed for draft animals has been reduced from a peak of 90 million acres before tractors came into common use to the present productive area of 30 million acres. It is expected that this area will be further reduced by the continuing substitution of machines for animals, so that an ultimate reduction to 12 million acres may be expected.

It is difficult to estimate the losses of acreage and fertility caused by erosion of topsoil. Observations on test plots have shown a loss of soil as great as 100 tons per acre in a single storm. During one storm in Southern California in 1938, there was a measured average erosion in the San Gabriel Mountains of the Angeles National Forest of 50,000 cu.yd. per square mile, with record drainages showing as much as 100,000 cu.yd. per square mile. There is no adequate record of the rate at which crop lands have been lost through erosion.

A person flying across the United States cannot help but see how the blighting fingers of erosion are extending into farm lands, particularly west of the Mississippi River. On the other hand, improved farm practices, contour plowing, terracing of slopes and better strains of seed have actually increased the yield per acre of crop lands in the past decade.

One of the highly uncertain factors in the problem is that of agricultural export, which for the past decade has been requiring the produce of from 40,000,000 to 50,000,000 acres.

It is estimated that the nation's population will continue to increase as it has in the past decade, producing a population of 170,000,000 by 1960, and 190,000,000 by 1975. In the last ten years, the growth of the Pacific Coast states has resulted in a population increase of nearly 50 per cent, and the seven far western states have had gains of from 25 to 50 per cent. East of the Mississippi, however, the largest gains

have been limited to approximately 15 per cent. It is evident that the greatest population upsurge in the nation's history is occurring in the West, where rainfall and runoff are below the average for the rest of the country.

The Water Resources Policy Commission strongly urges continuing surveys and studies which would reveal the amount of additional crop acreage required. It is possible that additional acreage by land drainage can be secured for less cost than would be entailed by much of the proposed irrigation. The commission concludes, on the basis of the best information available, that the rapidly increasing population, coupled with a probable continued rise in living standards, will wipe out present surplus crop conditions and require substantial additions to crop acreage.

Water Law

The Water Resources Policy Commission was fortunate in having a staff of legal consultants, drawn largely from federal departments acting under the chairmanship of Bernard A. Foster Jr., special counsel to the Federal Power Commission. This committee of lawyers prepared Volume 3 of the Water Resources Report, entitled *Water Resources Law*. The constitutional considerations under which the United States has engaged in water resources development under its commerce power, proprietary power, war power and general welfare power, and under equitable apportionment and interstate and international compacts are reviewed in this most useful document. A comprehensive study of existing legislation has been developed for all water uses.

Water is a property right which is subject to the laws of many states. The humid states adhere to riparian doctrine and English common law, whereas the seventeen western states observe the appropriative principle, "First in time is first in right." California and, to a limited extent, the state of Washington operate under both the riparian and appropriative doctrines. The legal report reviews the water law of the seventeen western states in a section prepared independently by Wells A. Hutchins of the Department of Agriculture.

Summary

America has been richly endowed with natural resources: extensive and varied forests, fertile lands and an abundance of minerals and fuels beneath the soil. Although many projects have been constructed to conserve and utilize water and land resources, the design, operation and financing of present federal, state and local programs fall far short of the opportunities and necessities for the future.

With the continued increase in population, much greater demands for water and land use development will undoubtedly occur. As shown in the compilation of water resource project costs (Table 1), projects planned and proposed but not yet authorized account for at least five times the total expenditures made to date plus the estimated costs of those under construction. Accumulated experience with nationwide programs offers intelligent guidance for the wise planning of river developments and for obtaining essential basic data. As most river basins are relatively undeveloped, there is still time to make the necessary plans and develop coordinated programs of water resources development. There is a sobering finality in the construction of river basin development, and it behooves us to be sure we are right before we go ahead.

Water Policy as the Engineers See It

By Abel Wolman

A paper presented on May 2, 1951, at the Annual Conference, Miami, by Abel Wolman, Prof. of San. Eng., Johns Hopkins Univ., Baltimore 18, Md.

I HAVE a somewhat disagreeable task to perform, certainly one which an engineer does not ordinarily undertake without a great deal of misgiving. I plan to depart somewhat from the strictly factual engineering features of national water policy and move into an area largely dominated by considerations of social philosophy. That I do so with a great deal of misgiving is, first, because it is not too familiar a field and, second, because it lends itself so easily to recrimination and to attack.

It is necessary to undertake the task, however, because, after long interest and experience in the field of water policy, I feel that we have moved somewhat beyond matters of engineering decision and must confront ourselves with problems of social philosophy. As General Chittenden of the United States Army pointed out many years ago, in discussing the problems of the Mississippi Valley, the greatest and most troublesome issues are not those calling for engineering decisions and diagnoses, but those created by the attitudes of man.

I want here, too, to add a disclaimer for myself. After having spoken on this topic in many areas of this country over a period of almost twenty years, I find such a disclaimer necessary. Whenever such criticisms as I feel I must make here are presented, friends of mine want to know what has happened to me. The interpretations I hear from friends and enemies are various, but all wonder what has happened to Abel Wolman: Is he against the "common good"? Thus I make this disclaimer because I want to assure everyone that I am "for" the common good; although I find that there are many ways of approaching it—some of which I find desirable and others of which I think are full of danger.

Whatever my comments here, they are not the result of having been disappointed in love—one of the additional diagnoses on the part of my more benevolent friends. That will not account for it. I may, of course, have hardening of the arteries, which others, perhaps less benevolent, have associated with their diagnosis.

In passing, I might also say that I am not against federalism. I recognize—and have recognized all my life—that there not only is a place for federal action, for stimulation, for integration on the part of a federal government of a great country such as ours, but a major necessity for it. And those comments I shall make upon increasing federalism are made within the framework of an understanding and acceptance that there is an important opportunity, necessity and responsibility for federal government.

The Road to Confusion

I want to add two more observations: First, I have learned not to pick out scapegoats in the problem of national water policy. It is very easy to say that the difficulties we are in are the fault of the Bureau of Reclamation, the Corps of Engineers, the Federal Power Commission, or the like. I think that is a shallow diagnosis. Those agencies are literally agents, or even victims, of national legislation. I want to pin the responsibility for the kind of difficulty in which we do find ourselves where I believe it belongs. It belongs on Congress, and, in turn, it belongs, of course, on every man and woman in this country. It is undesirable as well as inaccurate to use the easier route of charging agencies that have been created for certain purposes—frequently competitive—with the responsibility for leading us into a disorderly set of circumstances.

The scapegoat is neither the Democratic nor the Republican party. Those of you who are on the side of either of these political philosophies can take no great cheer in the fact that "if the Republicans had been in" or "if the Democrats had been in," there would have been no problem in national water policy. That, I think, is even shallower bunk than the original diagnosis. Need I recall to you the fact that the Rivers and Harbors Bill of the last session of Congress was almost unanimously approved by both parties with only six dissenting votes in the entire two houses? No, there is no solace in the feeling that, if one party or the other had been in power, those situations would have been resolved with the greatest of ease. It isn't true.

Now let me come to the factual situation which Mr. Morris has described with such skill and with such experience and in such detail. He pointed out to you in the last part of his document the size of the enterprise with which we will be confronted over the next few years. I might add to his comment that, prior to 1947, in a period of approximately 150 years of our national history, we spent less money in the water resources field in this country than in the period—as yet, not quite four years—since 1947. Although I am accustomed now to speaking in terms of expenditures which are quite unfamiliar, if not unintelligible to me in a personal sense—that is, in ten to the eighth or ten to the ninth power dollars—one of the difficulties in viewing the national water policy scene is that it is so great, that it is so complex and that it is so expansive in geography as well as in dollars that it becomes a challenge to any single individual or group of individuals to evaluate and to appraise, and to be able to distinguish between the relative good and bad.

What about orderliness in the development of a national water program? That's a good homely Anglo-Saxon term, which I like. But it is not found in the national water resources development program. Engineers are taught to have a sense of orderliness, they like to see "the data." They are even accused of being so quantitative that they become nonhuman. I do not think the accusation is fair. They should be quantitative; as a matter of fact, they're the last surviving quantitative "Indians" in this country. And it would be even a greater calamity if their quantitative evaluations and diagnoses and appraisals were to go by the board because of the charge that they are either antisocial or antihuman.

"Orderliness" is the survival of a technique which is highly essential to

our purposes. The President's Water Resources Policy Commission made a very interesting comment on this just last year: "There is today no single uniform federal policy covering comprehensive development of water and land resources." Consider that statement in light of the fact that forty years ago President Theodore Roosevelt said that he knew of no more distinguished mismanagement in the history of our nation than the mismanagement of rivers. That was in 1909, and it has been stated in messages by every president of this country since that time, Republican and Democrat alike.

Dilemma in Anachronism

That would seem to indicate that we are in a kind of social dilemma, a kind of social morass, from which it seems difficult for us to escape; and I find, incidentally, that the Water Resources Policy Commission itself had difficulty in escaping in some important considerations which I hope to enumerate.

Why do we get so excited about this—aside, of course, from the ten to the ninth power potential dollar expenditures? There are other reasons. Since 1934 there has been a tremendous acceleration of federal expenditure in the water resources development field. The acceleration took place in a period of recurring stresses, recurring dilemmas, which were not associated so much with water resources development as with economic stress and catastrophe. The period from 1934 to 1942 was perhaps the worst period in which to make major national decisions, yet most of the fundamental ones in water resources development were made in that period of stress and high emotion. Thus, I might say that my present position is a reaffirmation of my position in 1936, when I appeared personally before the President of the United States and attempted to have him resist the flood control resolution which, for the first time, abandoned the concept of major financial contribution by local areas. I felt, then, as a member of the National Water Resources Committee, that it was a great mistake which would lead to extravagant expenditure. And it has.

The national expenditure in flood control operation since that time has gone up almost a hundredfold. I associate much of that rise, not with the increasing damage due to floods, but with a change in social attitude coming out of a period of high emotion. I wish that we had not had high floods in the late 1930's and that we had not had the maximum droughts during the same period of economic depression; it would have saved us billions of dollars for the future, and, of course, we would have hung on longer to what I feel is a necessary prerequisite to careful expenditure—that is, local responsibility for reimbursement.

Flood and drought in that period also brought into play the grant-in-aid philosophy, to my mind—and I know this comment will cause many of my friends either to walk out of the room or write me off as a decrepit conservative—one of the great influences toward hasty expenditures in national operations today. The grant-in-aid principle has many merits. Its demerits arise from misapplication, abuse and unnecessary extension.

The Reconstruction Finance Corporation provides an example of abuse of a sound principle. It was also born out of depression philosophy and had a purpose at that time. As Herbert Hoover said in his recent testimony on RFC, it is difficult to understand its purpose in what I would describe as

the present age of fiscal "vitamins"—where we have nothing approaching a depression, where we have an excess of money, where we have sources of cash that seem so extensive they are hard to stem. What is the purpose now of using a philosophy that came out of 1933 and 1934?

RFC and Chamber of Commerce

I want to rehearse for those of you who didn't read former President Hoover's testimony what this system of easy money on a federal basis has led to in the RFC. Then I want to go to the opposite extreme and see what it is leading to in such a group as the U.S. Chamber of Commerce, to give you the other side of the picture. The latter social philosophers are falling into the same trouble, because they do not want to see the bandwagon go by without having industry, too, get on it.

Mr. Hoover presented an analysis of where some RFC loans went—loans that came out of your pocket and out of mine. There were 39 loans for hotels. Just what total social public service that supplied I don't know. My own feeling is that if I want to engage in operating a hotel I want to know which hotel it is and where my money is going for it. I was not consulted; I merely found myself in the hotel business—through my income tax.

Fourteen of these loans—and, incidentally, not the $10,000 ones but those in the millions—went to hard and soft drink manufacturers. That's an amazing place to inject federal stimulation.

Eighteen loans went to theaters and bowling alleys. Now, I am an advocate of the arts. I'm in favor of theaters—not so much of bowling alleys as I'm an inferior bowler—but again I feel I should exercise my selection in a strictly personal, direct fashion. I want to know which bowling alley I'm subsidizing. I don't want it done for me without my knowledge.

In addition, we had a series of loans—and this I know must have been very appealing to the women taxpayers—to beauty parlors out of federal money. To me this is an astonishing degradation—not from the viewpoint of morals and ethics, because that's very subtle, but a degradation in public policy. Women, however, need not be too upset as we had a parallel set of loans to poolrooms, not concealed as any other type of public service—just poolrooms. I guess their social value comes under recreation and wildlife.

Now, I've kept for last a single loan. Its amount was large, incidentally, and it may have had as its purpose certain medicinal values. The RFC made a loan to a snake farm. Perhaps I should not have jumped to the conclusion it was for medicinal purposes; it may have been a religious matter. But why on earth that 1932 institution, which did a marvelous, a valid and a necessary job when it was organized, should be so abused, it is difficult to say.

Turn, now, to the Chamber of Commerce. In its policies of 1951, under the heading of "Water Resources Development," it cannot resist pointing out that, if the federal government gives loans and grants-in-aid to municipalities for stream pollution abatement, it should also provide that income tax deductions be made available to private industry for stream pollution abatement work. There's nothing wrong in that philosophy, but how far does everybody want to go? Is there anything that should remain either for local responsibility or payment or for private initiative and payment when all kinds of people whittle it away?

Water Resources Issues

Now, what are the issues in the water resources field? They include: What kind of federal participation should there be in this field? (That's a simple question but very difficult to answer.) How do you appraise the validity of an enterprise? How do you choose between water enterprises and, more important, how do you choose between a water enterprise and any other of a dozen kinds of functions in this country? How does the water enterprise rate against a hospital or a school or a public highway? That's the problem.

What is the wisdom of the existing and proposed legislation? I have already referred to the fact that we have a competitive set of situations. What should we do about that—how do we determine feasibility?

The EJC Principles

The Engineers Joint Council created a panel at the request of the President's commission, in January 1950. It summoned the advice of about eighty U.S. engineers of all types of experience, and it posed these questions to them in general terms. The report was filed with the President's commission. It was long and to most people dull, and perhaps no one had time to read it, but I want to call to your attention just three principles that the Engineers Joint Council commented on—three fundamental principles. The council felt that in most undertakings one should insist upon local responsibility and local autonomy as far as possible. Everybody is aware you cannot do it completely; everybody is aware that, as the jobs increase in size and complexity, they become further and further away from local understanding and responsibility.

The council came out, secondly, for the fundamental principle of quantitative appraisal. That is a very unpopular thing. I am confronted all the time by the Bismarckian phrase that, although this project shows itself to be pretty low in visible benefits from an engineering standpoint, you ought to build it because it's for the common good. I have seen that deterioration running all through the fabric of our appraisal. The Engineers Joint Council thinks we ought to get back—even if we eventually throw it in the wastepaper basket—to an appraisal sheet, a quantitative relation between costs and benefits. In a period of less than presented that had a benefit-to-cost has dwindled to minus two. There was a time, of course, when no Corps of Engineers' project came in without such an evaluation. And as a general round figure, a project would have to have a ratio of benefit to cost of 2 to 1 before it would be recommended. I have seen that disappear. The ratios first dropped to 1 to 1, and then below. I recall the first time a project was presented that had a benefit-to-cost ratio of 0.5 to 1. I was still Chairman of the Water Resources Committee and I said, "How do you get this way?" "Well, we recommend this because of imponderables." Now "imponderables" means all those things you cannot evaluate. There are a lot of imponderables, and, before I am attacked, there are many good reasons for doing things that do not quite reach a satisfactory ratio of benefits to costs. But, I say, isolate them, put them down in another column. Let's see what they look like, let's see what "national defense" means. All kinds of things come in under the label of "national defense"—that's another difficult problem to evaluate and I'm not the person

to do it. But I like to see on the right-hand side and on the left-hand side what it costs to build concrete structures. That we still know how to do, and I think we ought to continue to do it.

The council report had a third axiom which I think is worth repeating time and time and time again. There is a limited amount of money available for projects. It's astonishing to say that there are self-limiting amounts of money even in a great country such as ours, which is the richest and, I might add, the most blessed country I know. Even here there's a limit to the availability of money. The council felt it necessary to point out that that axiom was wiped out by some kinds of social philosophy. I do not care whether it is money or wampum or what medium of exchange, it is still necessary to pay something for what we buy. It might be nicer if we didn't have to, but even Uncle Sam has to get the money from us when he spends.

At this point, I want to review the list of people who participated in the public water supply and stream pollution abatement work. They were J. H. Allen, M. B. Cunningham, J. C. Frye, R. E. Lawrence, F. W. Mohlman, S. T. Powell, A. M. Rawn and A. D. Weston. Louis R. Howson is the chairman and L. H. Enslow, the Coordinator. They came out flatfootedly for local repayment, they came out flatfootedly for preserving the responsibility where it has always been and where it is most likely to produce the greatest safeguard against wasteful expenditure.

Critique on the Commission Report

Returning to the President's Water Resources Policy Commission document, I know that my friend Mr. Morris will forgive me some comments, because I understand that I am one of the two people who have read Volume I. It is not a competitor of *Forever Amber*. It's an exciting document, but not bedtime reading in the same sense as some other volumes I know. In turning to the document, however, I want to report reactions which are not only my own but those of the nine subcommittees of the Engineers Joint Council. They have reviewed that document in detail. They have picked out paragraph after paragraph, and have made their comments, good and bad, straight down the line, on all of the functional features. That documentation will not be published, but will be available if and when the Congress views proposed legislation.

What are the findings? One thing they find—the book has some 770 pages—is a sharp contrast between the enunciation of the principles and the implementation of the policy that should follow from the principles. That is a general comment, a rather severe comment which probably stems from the fact that the volume is large and the subject complex. Possibly the document may have been assembled by a variety of people so that consecutive page statements are not in complete accord with a prior statement of principle. There are a number of such inconsistencies.

A second criticism is that they find it difficult to follow the reasoning which perpetuates a bad policy for one function, such as irrigation, and recommends the correction of a similar bad policy in another function, such as navigation. The general reader and, I rather suspect, the congressman, will find it difficult to determine why it is so obvious that, in irrigation, it's all

right to waive interest but in navigation, in which both principal and interest have always been waived, it is not and we should now see to it that, by a toll system, we get both principal and interest back. Because irrigation has grown up since 1902, it did not appear to the council that subsidy should be perpetuated indefinitely, particularly in view of the fact that in irrigation undertakings, repayment has been consistently whittled down for a period of half a century until, within the next ten years, it may reach the vanishing point. Such proposals are inconsistent with the sound statement in the same report, that: "A subsidy always results in private gain at public expense." It is difficult to understand why an Eastern farmer must buy his farm, at his own expense, on a mortgage loan to be repaid in full with interest, while a farmer in another part of the United States may now be subsidized almost 100 per cent on his water supply.

What is the basis of that philosophy except the desire to develop the country?—a desire we find getting more and more tenuous. I might say, here, too, there is a sharp difference of opinion, which I think ought to be resolved on the factual grounds of whether we need any more agricultural land. As Mr. Morris has pointed out, the commission finds that we do need more land. The expert panel on EJC finds we do not. It ought to be possible to resolve that issue. The council also made population estimates and they checked fairly well with the commission's. The council made detailed inventories on available lands in this country and the opportunities for export, and arrived at the fact that we do not need to open up such vast tracts of land, particularly against, as Mr. Morris pointed out, an increasing per-acre cost.

Some now propose to develop land at a cost of $1,000, $1,500 or $2,000 an acre when no amount of mental gymnastics will disclose that it will have a final value of more than $300 an acre after the water has been made available. For whose common good is that? Such enterprises run, incidentally, not into millions, but into hundreds of millions of dollars in cost.

More Inconsistencies

We find a sharp inconsistency in the statements in the President's commission document suggesting the necessity of preserving local responsibility and then suggesting basin structures which are so largely dominated by federal personnel, and by a chairman appointed by the President of the United States. Only in language has that preservation of local responsibility been assured, whereas in fact it would be practically nonexistent.

The commission pays only lip service to quantitative estimating of costs and benefits. It handles that objective in principle with such clearness that nobody can take issue with it, but later on, in effect, it says, "We don't mean positively" when it states: "The principle of full reimbursement has ceased to be useful or necessary." We find the statements quite inconsistent. Later on, the commission says that, after all is said and done, when you have made the evaluations, the decisions on any project should rest on social good.

If decision rests on as general a concept as social good, any project qualifies, because any project has some values to somebody. The number may be small, the unit cost high, but they certainly have some value. The impact

of the socially desirable and the imponderable unfortunately runs through the reports so extensively that it vitiates to no inconsiderable extent many affirmations of sound principles.

The commission recommends federal pollution abatement loans to local subdivisions of government at 2 per cent. Such loans are provided for in the existing stream pollution abatement act. Why we need federal loans for pollution abatement is beyond me. The country has lots of money, and, incidentally, I might say, many states and many municipalities have a better budget balance than the federal government. We have the ridiculous situation of a state, not far from my own, which asked the federal government for a grant of $75,000 for a design for a building. It has an annual budget of $175,000,000 and a surplus. Why does it go to Washington? When it was informed that when it built the building it would have to reimburse the $75,000, it withdrew the request. That's not poverty—that's a degradation of state and local responsibility. It's a sad example, which can be multiplied many times.

The President's commission recommended certain important adjustments in legislation. The legislative proposals have not been published. Why, I do not know. If we are not able to see them now, perhaps we will never be able to see them in their original form. They are going through the various federal agencies for adjustment and revision. Whether a composite piece of legislation, possibly bearing little resemblance to the commission's recommendations, will result, we do not know. The commission's proposed legislation in its original form should be made available for study.

Objectives of a National Water Policy

By Malcolm Pirnie

A paper presented on May 2, 1951, at the Annual Conference, Miami, by Malcolm Pirnie, Cons. Engr., Malcolm Pirnie Engrs., New York, N.Y.

A NATIONAL water policy must recognize that water is the one great natural resource immediately essential to the life of both plants and animals, that it derives its energy from the sun, and is, above all other natural resources, the most essential to the existence of man upon the earth. It is unique in that it is recurring by precipitation, it is pure in each recurrence, and it is not conserved by nonuse.

When precipitation descends to the earth, the raindrops absorb oxygen from the air, and carbon dioxide, which is present from combustion of hydrocarbons, on the land. Such water in the soil, together with sunlight, is the basic component of vegetable life.

The quantities of water on the surface of the earth and in the ground vary widely according to location and elevation and as precipitation varies from time to time. The continuous circulation of water over and through the earth, its recapture by the atmosphere (as water vapor) and subsequent precipitation perpetuates its continuing recurrence in essentially the same average annual quantities.

Washing the land and receiving man-produced wastes pollutes the water in its courses to the oceans or seas, but it returns to the earth essentially pure. So far man's activities have not diminished the quantity nor impaired the quality of the water supply serving the earth, neither have they affected measurably its rate of circulation over and through the earth and in the air. Therefore, the water supply for use by future generations has not been changed.

Given these circumstances, conservation of water is limited to economically feasible works constructed to retard flood flows, to equalize daily flows and improve the flow in extended dry seasons and to recover from falling water the residual portion of solar energy expended to continue the hydrologic cycle.

Nature has thus prescribed and demonstrated for the land in each drainage area the average amount and distribution of water supply as precipitation. There is no method known by which man can increase or redistribute to an appreciable extent nature's established supply of clean water.

Each river basin is bounded by a watershed line common to its own and the next adjacent drainage areas. A watershed is, therefore, a natural land boundary line on either side of which water from precipitation flows to one of two separate rivers. Watersheds do not conform to political boundary lines. Many entire counties and parts of counties in several states may be bounded by the watershed of one river. The

watersheds of the major American river drainage areas and those smaller drainage areas discharging directly to the oceans on the east and west coasts, include not only all of the land of the continental United States, but also land extending north into Canada and south into Mexico.

The atmosphere above each area of land played an important role in establishing its topsoil, natural vegetable cover, surface streams and ground waters. The land upon the earth's surface is jungle or desert as the atmosphere above it varies from extremely humid to extremely dry. Thus the productive value of land and the water delivered from its overlying atmosphere are inseparable.

Basis for Government Action

The great incentive to form and defend the United States is set forth clearly in the last clause of the stated objective of the nation's Constitution: "and secure the blessings of liberty for ourselves and our posterity." This is why it was necessary "to form a more perfect Union, establish justice, insure domestic tranquility, provide for the common defense [and] promote the general welfare." In these five actions there is no hint that the new union should undertake the financing, planning, construction and operation of works to reduce large differences in seasonal flows of river systems, provide pure sources of adequate water supply for domestic, agricultural and industrial uses, and capture power from falling water. Such activities obviously were left to private initiative within the jurisdiction of established justice.

The striking nature of this most essential natural resource and the natural level of government that should administer such justice as is required in its regulation can be summarized as follows:

1. Water is the unique natural resource which cannot be conserved by abstaining from using it.
2. For each drainage area the average annual recurrence of water as precipitation is constant.
3. However much it may be soiled in its travels over and through the earth, water recurring as precipitation is pure.
4. The character of life upon a drainage area is equally dependent upon the land and upon the atmosphere overlying it.
5. To secure the blessings of liberty for themselves and their posterity, the inhabitants of lands within and near the watershed of a river drainage system have a continuing responsibility. Their elected local representatives should select those competent to approve private or local government proposals to plan, finance, construct and operate works that will provide the benefits which are found to be economically justified. Accordingly, the established government of the state embracing an intrastate river basin or the governments of the several states, acting jointly by compact when proprietary of an interstate river basin, should be the highest levels of government to assume full responsibility for approval of private or local government projects for providing and paying for the desired benefits. Obviously, federal participation is not precluded. It is required to the extent of congressional approval of interstate compacts and the federal government should also pay the costs of any contributions made by projects to the national defense.

Interstate Action

The states of New York, New Jersey, Delaware and Pennsylvania, in which the Delaware River Basin is located, are on the threshold of making history in sound conception and organization of river basin development. The Interstate Commission on the Delaware River Basin, "Incodel," in "A Message to Those Who Care" from Francis A. Pitkin, Chairman, presented a specific project for the utilization of the waters of the Delaware River Basin and stated:

The United States is the youngest major nation in the world. It is also the most progressive, prosperous and powerful.

When broken down to fundamentals, our country's rise to its position of prominence can be traced to two attributes, one God-given, the other, man-controlled: (1) an abundance and diversification of natural resources; (2) a constitutional system of self-government that has no peer.

"How long can the United States continue to occupy its pinnacle of prominence? The answer depends upon how effectively it utilizes and conserves its natural resources from this point on and upon how tenaciously it clings to the principles of government which have served it so well. It is generally agreed that both of these assets are now being imperiled.

The project "embraces both of these essentials for keeping our country strong . . . is a highly important item of an overall program for the conservation of the replenishable resources of the valley —its waters, soils and forests.

It is recommended that the project be financed, constructed and controlled by an administrative agency representing and directly responsible to the people of the states in which the project is located and which the project will serve—Pennsylvania, New York, New Jersey and Delaware.

This is a marked departure from the course being generally followed in other sections of the country, particularly the South and West, of handing jobs of this kind over to federal government, a practice which is gradually destroying the doctrine of self-government and is grossly inequitable to the East.

This undesirable situation should be promptly corrected. Adoption of the proposed water project by the states of Pennsylvania, New York, New Jersey and Delaware would be a long step toward the attainment of that objective. By such action the "Delaware Basin" states would not only be providing a tremendous public service for their own citizens but, at the same time, would be setting a splendid pattern for a sound water policy for the entire nation.

It is a brave challenge. I am firmly convinced that the states will exercise the kind of selflessness and political sagacity required to meet it.

In the Incodel brochure, under the caption "A National Water Policy," are the following paragraphs:

The proposed project for the utilization of the water resources of the Delaware River Basin briefly described in this brochure presents an opportunity to the elected representatives of the people of New York, New Jersey, Pennsylvania and Delaware to exercise a quality of statesmanship of the highest order.

The problem is simple; the issue is clear. The United States Supreme Court has decreed that the waters of the Delaware River system are a treasure of life that must be rationed among those who have power over it . . . the states of New York, New Jersey, Pennsylvania and Delaware. The proposed project constitutes a plan for the equitable sharing of that treasure. It would be operated by a Commission, created by interstate compact among the four states, with

equal representation from each of the signatory states. Under the terms of the compact the interests of each of the states are carefully protected and safeguarded.

The project should become a reality. It is feasible, advisable and urgently needed. It would be generally beneficial to everyone it affects with the possible exception of owners of property which would be flooded. The Delaware River Basin will provide plenty of water to meet the reasonable needs of all four states, if it is properly developed and conserved. If the project is appraised with an open mind and on a constructive basis, it will be found to be sound and advantageous.

If the states adopt and make a success of the proposed water project, they will be establishing a pattern for a national water policy which would be of immeasurable value in preserving the principles of self-government.

It is believed that the policy of unity of action through interstate cooperation is far superior to such alternatives as that recommended by the President's Water Resources Commission, calling upon the Congress to create federally controlled river basin commissions to plan and control river basin programs.

The eyes of the nation are focused upon the four Delaware Basin states to see whether they actually are willing and competent to work out their river basin problems on a cooperative basis.

The opportunity to prove that it can be done rests with the elected representatives of the people of these states. It is a glorious opportunity. Won't you encourage them to make the most of it? It may be the last chance.

Legal Basis for Incodel

Incodel was created less than twenty years ago. It was conceived in the light shed by the opinion of the Supreme Court of the United States, delivered by Justice Holmes on May 4, 1931. Unmistakably sound interpretation of the objective of the Constitution of the United States stands out in this historic opinion, as evidenced by the following quotations:

We are met at the outset by the question what rule is to be applied. It is established that a more liberal answer may be given than in a controversy between neighbor members of a single state. . . . Different considerations come in when we are dealing with independent sovereigns having to regard the welfare of the whole population and when the alternative to settlement is war. In a less degree, perhaps, the same is true of the quasisovereignties bound together in the Union. *A river is more than an amenity, it is a treasure.* It offers a necessity of life that must be rationed among those who have power over it. New York has the physical power to cut off all the water within its jurisdiction. But clearly the exercise of such a power to the destruction of the interest of lower states could not be tolerated. And on the other hand, equally little could New Jersey be permitted to require New York to give up its power altogether in order that the river might come down to it undiminished. Both states have real and substantial interest in the river that must be reconciled as best they may be. The different traditions and practices in different parts of the country may lead to varying results, *but the effort always is to secure an equitable apportionment without quibbling over formulas.*

In a most competent and excellent report the master adopted the principle of equitable division which clearly results from the decisions of the last quarter of a century. Where that principle is established there is not much left to discuss. The removal of water to a different watershed obviously must be allowed at times unless states are to be deprived of the most beneficial use on formal grounds. In fact, it has been allowed repeatedly and has been practiced by the states concerned.

Scope of Government Action

The people of this country are too enlightened to believe that any level of government can emulate the sorcerer's apprentice and change nature's demonstrated water cycle materially. If for each area of land the average annual precipitation is constant, magic can be cast aside for plain ordinary common sense, engineering skill and highly developed construction procedures. Works can be planned to provide any desired degree of regulation of the volume of water supplied by precipitation. The costs can be estimated and, if those who will benefit are willing to pay for operation, amortization of cost within a reasonable time and a fair rent for the money needed, the works required will be built in the future as they have been in the past.

The Congress should test every request for federal construction and operation of works to regulate the waters of any river basin by affirmatively answering this question. *Will this and continued similar procedures contribute materially to our constitutional objective "and secure the blessings of liberty for ourselves and our posterity?"*

If the answer is *Yes,* the Congress should regard itself as trustee of our savings which it will collect as taxes and make them earn a fair return in benefits for ourselves and our posterity. Minimum mandates to this end would appear to require compliance with the "Policies of General Applicability" recommended in the "National Water Policy Study" of the Engineers Joint Council. The federal government then would be in fair competition with private and local government proposals to undertake comparable developments. This would challenge private, interstate, state and local agencies to build their own needed works and minimize demand for federal participation in constructions and management within the nation's watersheds.

Logical sequence would seem to demand a clear definition of objectives before attempting to define a policy for any purpose. Perhaps there would be agreement upon a sound and beneficial national water policy if its objectives first could be clearly specified and nationally accepted.

Discussion of National Water Policy

Panel Discussion

A panel discussion presented on May 2, 1951, at the Annual Conference, Miami.

Dale L. Maffitt

Gen. Mgr., Water Works, Des Moines, Iowa

The development of the water resources of the Missouri River basin—a region comprising one-sixth of the area of the United States—was at first conceived differently by the two federal agencies having jurisdiction. Although their engineers were highly competent, and must be highly regarded, the Army's Corps of Engineers differed considerably with the Bureau of Reclamation on the proper uses and amounts of water in the basin. After much study and consideration, however, a common agreement was reached on the disposition of water for navigation, irrigation, flood control, sanitation and other uses. This agreement, embodied in what is known as the Pick-Sloan plan, has been authorized by the Congress and forms the basis for the program now being developed.

On various occasions the governors of the states in the basin have gone on record opposing a Missouri River Authority, and they have forwarded a resolution to this effect to the Congress. They have expressed their corollary conviction that the people in the area would expect and want to pay their fair share of the cost of the project—an enterprise which includes more than a hundred major dams. The real test of the direction that will be taken by this project hinges upon the determination of who will operate the various works after they are constructed. That question is now before the policy-makers for decision, and it is being investigated—as it should be investigated—by those who have a real interest in the matter. The theme of all of these discussions, which this writer can only reiterate and reemphasize, is that real consideration must be given to all river development projects by qualified and ethical engineers who have the real interests of the communities affected at heart, and who can evaluate the proposed works from an economic and practical point of view.

Particularly in these days of rising costs, it should be the business of every citizen to interest himself in the works proposed for his state and to express his feelings to his congressman. In turn, the latter should carefully weigh the cost of the projects against the benefits to be obtained from them, taking into consideration all costs and all benefits at all levels—national, state and local.

A. G. Matthews

Chief Engr., Water Survey & Research Div., State Board of Conservation, Tallahassee, Fla.

The voluminous recommendations of the President's Water Resources Policy Commission have been thoroughly

covered by the preceding authors. In their discussions, as in the recommendations of the President's policy commission, we find some conflicts of ideas, and some widely different ideas of basic principles and objectives. Let us examine these differences, discover the reasons underlying them, and thus at least bring the fundamentals to the light of day.

Even a cursory glance reveals very quickly that water resource development has become one of the battlegrounds between conflicting political and social philosophies. In possibly oversimplified terms we might divide these combatants into the following groups:

1. Those who resist any change in government or society.
2. Those who seek dictatorial powers for themselves.
3. Those idealists who desire instant attainment of the millennium.
4. Those who seek progress in step-by-step fashion.

In more common phraseology we might call these stand-patters, the bureaucrats, the do-gooders and the traditionalists. The term "traditionalist" is applied to this last school of thought in full recognition of our unique American tradition: major betterments, effected in step-by-step manner with time between steps to adjust our economy and our lives to changed conditions, and with time to obtain and evaluate experiences upon which to base our next step. It is probably quite obvious that the writer is partial to this last school of thought.

Just to complicate this picture, in most of these major groups there are subgroups with opposing ideas. We find the same proposal backed by groups with completely divergent aims. One of these groups actually seems to be trying to set up a welfare state by using water resource development as the tool by which to accomplish this. Advocating generally the same alterations in existing policy we also find those who are completely opposed to the establishment of a welfare state. This group proposes the same new policies so as to obtain efficiencies and to reduce the outlay of federal funds. Thus we find the lunatic fringes and the economic royalists both advocating the same policy of consolidation. Under these conditions the wonder is that the President's commission was able to avoid even more confusion.

Agreement on Fundamentals

The writer suggests that we can clarify much of the existing hodgepodge of ideas and eliminate most of the major conflicts if we can state a few simple fundamentals and agree on them: the primary purpose of water development work, the basic purpose of our form of government and the reason that government is justified in dealing with water matters.

It is believed that the only excuse for executing water development projects is to benefit the human users of water by correction of the existing surpluses and shortages of that commodity. Let us content ourselves with this reason. Let us not mix up the development of our water resources with its possible use as a tool of social reform, or as a means to make some other basic change in our national social, economic or political organization.

This raises the question as to what we mean by "benefits to the human users of water." Fundamentally it might be said that human beings use water for domestic purposes; for transportation; for crops, forests and ani-

mals; for fire protection and sanitation; for industry and construction; and for generating power. Too much water in the wrong place at the wrong time has cost us much treasure and many lives, so that protection from such disasters is also a legitimate "use" of water. Human benefits also accrue from the uses of water for recreation; for fish and game; and for just sheer pleasuring of the eye and the soul.

The question next arises as to just how the federal government fits into the matter of providing these benefits. As brought out by Malcolm Pirnie [this issue, p. 410], it is the constitutional obligation of both the federal government and each of the several states to promote the common welfare. Major betterment of existing water conditions nowadays frequently involves such huge outlays of capital as to be beyond the financial ability of private corporations or even local governments. Yet these betterments are vital to the common welfare. To fill this money gap, the great common purse of all of the people is called upon to assist the local people for their own benefit, and the consequent benefit to the state and nation.

It would be wise, in considering governmental assistance in these matters, to keep always in mind the fundamental object for which we established and still maintain our form of government. The fundamental reason for the establishment of government in this nation is not clearly stated in the Constitution, but rather in the closely reasoned second paragraph of the Declaration of Independence. In paraphrase that document stated as self-evident that all men are endowed with certain inalienable rights, and *that governments are instituted among men in order to secure these rights*. That is the primary purpose of government as we Americans understand it: to secure our inalienable rights, our civil liberties.

Our government may be the most efficient dam builder, road builder and water resource developer, but if our people lose their civil liberties, or their civil rights are impaired, then our government must be condemned as inefficient no matter how efficient its performance of construction tasks may have been. Let us always keep this criterion of governmental efficiency in mind in planning or proposing changes in our situation for the more efficient performance of minor governmental tasks, such as building canals or irrigating the Far West. The primary task of American government is not building, but protection of our liberties. If we can build without endangering those rights, well and good. If we cannot build without sacrificing those rights, then we should not build.

Dangers in Centralization

The engineer and the soldier much prefer good tight organizations with clear and definite lines of responsibility and authority stemming from a single central source. This concentration of power is the most efficient in getting practically any task done. Because human nature is as it is and has been, however, in government we find that concentrations of power in an individual or group have always resulted in outright tyranny and loss of civil liberties. The proposal to concentrate power over all water resource development in the United States into the hands of a single agency, or a single group of individuals, or a single appointed board of review, would probably result in efficiency if we could pick the right people. At the same

time this would concentrate a tremendous amount of power over huge sums of money, and over huge projects which would insure (or prevent, if not constructed) the prosperity of major regions in the United States. Consequently, this writer views this proposed concentration of power as radical, unwise, and dangerous to the civil liberties of ourselves and our children. Nor is this a trumped up and improbable suggestion, for the writer understands that certain water resource development projects have already been used by local bureaucrats as political whips to insure "proper" voting in the benefited areas.

Most of us, at one time or another, have had to deal with monopolies of one sort or another, either private or governmental. Most of us have also had dealings where more or less free competition existed. It is the writer's opinion that a reasonably coordinated competition yields much better service to the public than does almost any monopoly, either private or governmental.

Coordinating Machinery

The Hoover Commission, the President's Water Resources Policy Commission, and several of the speakers today, have proposed coordination in water resource development by means of a "Board of Review." There is no question that some such coordinating agency is vitally necessary for economy and for concerted effort. The writer seriously questions the wisdom, however, of setting up any group which would have so much power for good or evil, yet which would be subject only to presidential control or whim. Particularly does this procedure appear questionable when, within the existing framework, there is already established the basic machinery and authority necessary to accomplish this very task. Moreover, the individuals involved in that machinery are right under the thumb of the people as a whole. Any time this machinery does not function in accordance with the wishes of the people, the personnel composing that agency can be changed. In addition, that machinery is already equipped with integral, time-tested checks and balances, counterchecks and counterbalances. This description, of course, applies to the two houses of Congress, each of which through its appropriate committees can act and has acted as a board of review. Some changes in the duties and responsibility of these committees, and some consolidation of function, do appear desirable. But these can be effected simply within the existing framework.

In other words, a point has been reached in our national life at which much new plumbing must be installed. Three choices are open to us: we can burn the existing mansion down and build a new one, with new plumbing; we can build a shanty out behind the barn and put the plumbing in that; or we can install the new plumbing with some minor changes within the beams and columns of the house. The writer submits that it is only common sense to install the plumbing in the existing house with as little cutting of main beams and columns as possible, and to employ plumbers rather than the most expert of our social philosophers.

Justification for Projects

The President's commission and the previous speakers have touched on the matter of economic justification for water development projects. Most agree that the benefits from a project should exceed the cost of constructing and maintaining it. Those supporting

this contention cannot be condemned as economic royalists, nor as those who put money above people. In the light of the American tradition and experience, any other course seems entirely untenable.

A common yardstick should be established, applicable to all types of water resource development. The President's commission failed to provide one; that omission must be regarded as a major failure on the part of that body.

Setting aside for a moment the bitterly controversial matter of competition in the power field between government and private enterprise, let us agree in principle that in most projects there are many tangible benefits which can be precisely evaluated in dollars and cents. Most of these readily measurable benefits are local. There are other benefits which, while intangible and difficult to value, are still very real. For example, let us look at only two of the benefits to our national defense accruing from hydroelectric power.

In time of war our transportation systems, both overland and overwater, are so overburdened as to handicap the necessary movement of troops and supplies. Every ton of fuel for power generation which can be saved by use of hydro-power reduces that burden on our transport.

Moreover, our machines of battle on land, sea and air are fuel-burning prime movers. Every ton of our limited reserves of fuel that we can save by substituting hydro-powered for fuel-powered electric plants adds that much to our future capabilities in battle.

In addition, our defense depends largely on our ability to reduce iron ores and produce steel. These operations in turn depend upon the use of coke, both as a source of heat and as the source of carbon for the chemical reaction. For this purpose we again should conserve our coal reserves by the substitution of hydro-power for fuel burning plants.

It is obvious that for these purposes hydroelectric power yields benefits to the national defense. It should be equally obvious that as our reserves of oil, gas and coal are depleted, these benefits become larger and larger. The derivation of any exact figure for this benefit seems difficult. But it does seem possible to set an arbitrary sum as at least a gesture of recognition of these intangibles.

Along with these, there are many others which are actual and real, but not evaluated. For example, what benefit value can be assigned to the provision of a suitable supply of water to a municipality? Or what value can be assigned to the national benefits resulting from establishment of a waterway or a port?

These and similar intangible benefits to the national economy, the national defense, the national conservation of resources and the national development are admittedly beyond the purview of both private enterprise and local governments. These are very properly concerns of the central government. That agency should therefore set up yardsticks by which to determine the degree of national benefit of and national participation in a project.

Controversial Issues

In the controversial question of government sale of power it is also possible to get down to fundamentals. In the last analysis the government consists of the citizens of the country. We, the actual government, discharge our function through an elected admin-

istration divided into three branches. We, the citizens, provide for the cost of this administration by taxes. Since there is no tax not ultimately passed on to the consumer, we, as individual consumers, thus pay for the cost of our administration by pooling contributions from our individual private incomes. These incomes are derived from wages and salaries for our services. These services are rendered in competition with others.

In general, it thus appears contrary to our own interest for our elected administration to engage in revenue-yielding enterprises in competition with enterprises of individual citizens. That statement makes a good basic principle, but on many specific occasions we find that private enterprise cannot or will not furnish the necessary service. Also we find that needs of national defense frequently justify the use of our common purse to establish a service. In such circumstances the vital utility should, indeed, be established by the government—that is, by all of us. Our elected administration is not justified, however, in using our common purse to provide one politically favored region with government services at less than the cost of those services, making up the resulting deficit from taxes collected from other areas less favored by the administrators to whom we have delegated certain limited responsibilities.

Another controversy is due to the basic incompatibility existing between the farm price parity program and the irrigation program. This incompatibility makes difficult true evaluation of irrigation benefits. On the one hand, a group of administrators is busily engaged in building great works to make the desert bloom like the rose. The object of these works is to make large areas suitable for the raising of crops. Yet when those crops are raised, they constitute a major burden on the federal treasury. Under the farm price parity program for crops, the farmer on government irrigated areas is paid a subsidy for raising or for not raising those crops. Thus, under this situation the actual reclamation of the desert may become not a benefit, but a detriment, obtaining large sums of money from the federal treasury both coming and going.

Another favorite idea of some groups is that of dividing the United States into major stream basins for the purpose of developing the water resources of those basins in a completely integrated fashion. From an engineering standpoint this seems to be truly efficient. From the standpoint of the states involved in some of these larger projects this idea is disliked. It appears evident that whether or not this idea has merit, the people as a whole do not accept it.

At the present time, certainly, the disadvantages of the basin authority idea are more apparent than are its advantages. One of the drawbacks to the concept of basin-wide organization is the justified suspicion of the common sense and motives of the individuals who are loudest in their advocacy of this proposition. Some of these proponents, although sincere and earnest, are long-haired idealists without common sense. Other proponents fall under the suspicion of being either outright socialists or potential bureaucratic tyrants. Here again, as in the overall subject of water resource development, we find political, social and governmental philosophies colliding and conflicting, all striving to use the civil engineer's job as a tool to effect a major governmental or social change, and as

a whip to enforce obedience to that change. It is the writer's opinion that a basin's water problems can be treated as a whole only within the existing framework of the political entities and sovereignties contained in that basin.

Fred Merryfield

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The first volume of the imposing report of the President's commission is entitled *A Water Policy for the American People,* and certainly the summary of this volume, along with that of the Engineers Joint Council report, should be distributed as fully as possible for the people to read, because intelligent action on national water policy requires an understanding of what is in these documents. The third volume, on water law, is less general in application, but it has value to every practicing water works man.

One criticism which could be offered of the report is that the staff work was done by personnel drawn from various federal agencies. As a matter of courtesy, it might have been advisable to have included all state engineers in charge of water development projects. Local conditions would then have been understood and presented much more clearly. For example—and the writer is choosing an illustration bearing upon his own provincial experience—in the discussion of the Columbia River, the statement has been made that "The impending completion of several dams across the Columbia and Snake Rivers has placed in doubt the maintenance of important runs of anadromous fish [salmon] in these streams." There are many people in the Pacific Northwest today who can testify that this hazard was clearly foreseen and who would ask: "Whose fault is it?"

To make such statements indicates the lack of real understanding of the regional background. And, of course, the occurrence of many errors—perhaps inevitable in so immense an understanding—indicates that the work was compiled from many sources and performed under pressure. The value of the report suffers from being compiled under such circumstances; more time should be allotted to this work.

The rights of federal, state and local government stem from the Constitution, the interpretations of the Supreme Court, congressional, state and local legislation. The remainder of our rights leaves most of us almost wards of some government agency. Because of an early background in traditional England, this writer inclines towards the traditional, unwritten moral code, rather than toward a constitution. Because of this tendency, certain trends that seem to be developing appear in a rather disturbing light.

Conflict and Confusion

Some of the federal engineering agencies are in direct competition, not only with one another, but occasionally with private engineers. Much duplication of effort has resulted, and much needless expenditure of time and money. Many of the estimates for some water projects appear to have been made from horseback surveys and random field notes, and these estimates have been rushed into print as if a race were in progress. Locally such hasty appraisals are often taken for what they are, but nationally there does not appear to be any such understanding.

Hearings—often required by law—are usually held to obtain local reaction to water projects, but the cum-

bersome technique of requiring a farmer to render a full statement in quintuplicate can often prevent a statement of consequence from being presented. Often local residents believe that construction of the project is a foregone conclusion, even before the hearing is held. Usually this belief is not well founded, but on the occasions when it has been, the situation has been damaging to all concerned.

There is also the problem of the exaggerated value we too often attach to our own opinions and preconceived notions, in believing them to be right and even in considering any question of them to be an affront. This failing is one to which engineers are not immune and, as a result, clashes of opinion may occur at hearings which may not be resolved upon purely factual grounds. It is difficult for a layman to contradict an engineer on a technical matter, even though the layman may be better informed about it than the engineer.

The initial estimates of the cost of some of the larger water projects sometimes bear little or no resemblance to the final cost. The discrepancy may be due to difficulties encountered on the job, to the lack of direct interest in regional conditions or to the belief that a benevolent Congress will provide.

Indifference to Local Needs

Engineers on the local level are usually more conscious of local needs, but conversely they lack a national viewpoint. Indifference to local water supply problems occurred at the field level, however, on at least two occasions last year, and it is to be hoped that the examples to be cited do not constitute a significant trend.

The superintendent of a well known northwestern town became deeply concerned, last summer, by a large and rapid increase in turbidity in the river from which his supply was obtained. The cause of the disturbance was easily located: a contractor—also well known—was dredging the river bottom several miles upstream, in preparation for the construction of a very large dam. The water superintendent discussed his problem with the federal resident engineer, and was very solicitously referred to the superintendent of the contractor, who gave him the same treatment in reverse. There was a clause in the construction contract designed to prevent such difficulties and compensate for damages, and the water superintendent accordingly wrote to suggest the establishment of an independent board of review composed of engineers to resolve his problem. Unfortunately it must be reported that he was severely put in his place by the resident engineer, and in a rather contemptuous manner.

Another example of a disturbing indifference to local problems was exhibited by a group of federal engineers who were studying a domestic water distribution system being planned to serve a very large area, including several towns. The largest of these towns had engaged an engineer to study its own supply problem, but the federal agency's report—obviously nonfactual and hurriedly prepared, although it purported to contain estimates of cost—was not made available to the city. After the city's consultant had prepared his own study, however, the agency issued a new and drastically revised report. The original report had included a repayment interval 1.6 times the life expectancy of the pipe recommended. The revised report ignored completely the value of a new \$275,000 reservoir, and proposed a salary for the future water super-

intendent that was less than that of the agency's own engineering aide. There was little or no evidence that the writers of the reports were competent in the field of water supply.

The examples cited are not to be considered representative, but the tendencies in which they have their roots do have a damaging moral effect upon all of us. Nor are these tendencies the monopoly of any agency—federal, state, local or private. They are individual manifestations and are to be deplored as such.

Room for Federal Action

The writer cannot agree that all water problems can be solved at the state level. A review of the appropriative water rights in the seventeen western states, and of the riparian rights in the eastern states, will resolve many misunderstandings. The amount of land owned by the federal government in the West further increases this complexity.

Solution of water problems by the states is also made difficult by the many uses for which water is needed and the growing competition—between towns, states and even drainage basins—for the available supplies. At least three bills were introduced in the Oregon legislature intended to prevent the state of California from taking water from a river which rises in Oregon. Many of these conflicts take the problems out of the hands of the engineer and turn them over to the courts or to political contests for solution.

It is essential for all concerned that state and local rights be decided upon their true merit and after reasonable compromise. It is equally essential that individuals and states recognize the broader obligations of the national government. A more selfless and open-minded attitude is needed by all of us. But certainly the federal government might save much money and manpower by avoiding duplication and overdesign. These savings might then be expended in the states on fact-finding groups instructed to obtain the hydrologic, meteorologic, topographic and geologic data so desperately needed by all those in the field of water supply, so that future estimates will be more accurate and construction more appropriate.

Safety Practices

Task Group Report

A report by Task Group A2.E—Safety Practices, presented on May 1, 1951, at the Annual Conference, Miami, by Raymond J. Faust, Chairman, Executive Asst. Secy., A.W.W.A. The other members of the Task Group are Jerome C. Zufelt and Jerome Powers.

TASK Group A2.E on Safety Practices was assigned the task of "developing an outline of safety measures for water works as they relate to construction and operation . . . to public and employee safety . . . and to the activities of men engaged in water distribution, station operation, water treatment plant control, laboratory operation, and warehouse and repair shop operations."

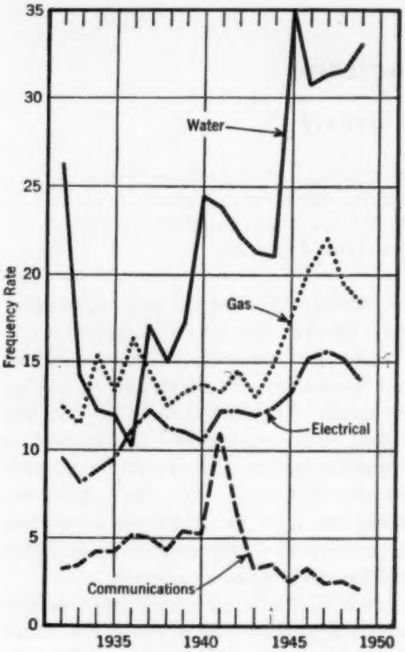
In approaching this assignment the task group chose to follow the suggestion of W. R. LaDue, Chairman of the Committee on Water Works Administration, to divide the outline into eleven major parts:

1. Supply
2. Treatment
3. Pumping
4. Storage
5. Distribution
6. Meters and services
7. Meter reading and billing
8. Machine shop and garages
9. Automotive equipment
10. Construction equipment
11. General construction

The outline as submitted (see Appendix, p. 429) is not as detailed as the task group could have prepared; however, the group believes that it covers most if not all items of consequence. Details may be added by subsequent committee action. Item 11, "general construction," taken from the *Manual of Accident Prevention in Construction* (1) of the Associated General Contractors of America, Inc., comprises an inspection checklist and is rather complete. In fact, the entire outline might be considered an inspection checklist and as such should be of value to the industry. Its chief purpose, however, is to guide future committee action in the preparation of a water utility safety practices report.

Safety, both personal and public, needs attention and study in the water works industry. Records of the National Safety Council (2) show clearly that the accident rate of water utilities has placed them in an unenviable position, compared with the electrical, gas and communications utilities. For example, the frequency rates of disabling injuries for each 1,000,000 man-hours of work (Fig. 1) in the four utility groups for 1949 are: communications, 2; electrical, 14; gas, 17; and water, 33.

Accident severity rates (Fig. 2) for the same year put the water utilities in a more favorable light: communications, 0.15; water, 0.90; gas, 0.99; and electrical, 2.37. Severity rates are based on days lost for each 1,000 hours of work. These figures tend to show that, although more accidents per work unit occur in water utilities, those accidents are only moderately severe. It is to be noted, of course, that the statis-



Courtesy National Safety Council

Fig. 1. Accident Frequency Rate

The number of disabling injuries incurred for each 1,000,000 man-hours of work is shown for 425 gas utilities (the number given is the total reporting in 1949), 238 electrical, 59 communications and 33 water utilities.

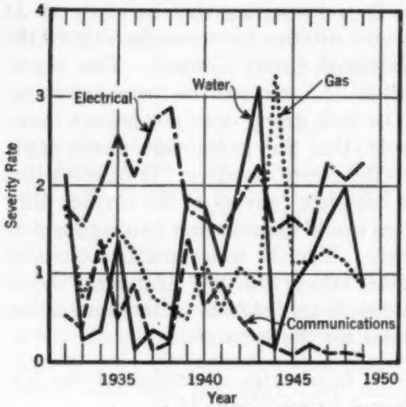
tics are based on the experience of only 33 water utilities, whereas 425 gas companies, 238 electrical utilities, and 59 communications utilities reported. It is possible that the small number of water plants covered in the survey may have seriously interfered with the accuracy of the results. Nevertheless, these statistics were the best that were available to the task group, and they are indicative of the need for better safety methods in the industry.

It might be beneficial to call attention to the fact that, in 1949, the frequency rate for accidents in all classes of industry in the country was 10.14, and the severity rate was 1.02. This means that the frequency rate for accidents in water utilities was 3.2 times greater than the average for all industries and the severity rate for water utilities was approximately equal to the national average for all industries.

Safety Programs

The need for a personal and public safety program for water utilities is obvious. No system is too small or too large to escape this need. Some of the larger water utilities already have fine safety programs and have trained personnel on their staffs. The Los Angeles Dept. of Water and Power has a safety engineer who has prepared a very fine brochure on "Water Works Safety." The American Water Works Co., Inc. also has an excellent brochure on "Safety Rules and Regulations." These brochures together with the outline prepared by this task group might well be the basis for future committee activity.

The task group also wrote to the departments of labor and industry of the 48 states to "ascertain what special agencies in the various states concern themselves with safety measures both during construction and in the operation of a property, particularly in the water utility field." Replies were received from 41 states. In almost every state the agency dealing with labor and industry was the regulatory body for the administration of safety practices. Eighteen of the 41 states have "safety codes" for general construction practices. Some of these codes include safety measures to be followed in work on trenches, caissons, tunnels and other construction facilities, and would apply to water utility operations. Eight-



Courtesy National Safety Council

Fig. 2. Accident Severity Rate

The number of days lost for each 1,000 man-hours of work is shown for the same utilities furnishing the data for Fig. 1.

een states admitted the absence of general building codes; five states have codes that are limited in their coverage.

None of the 41 states reporting claimed to have a safety code specifically covering water works construction and operation. Several of the states, however, called attention to the activities of the industrial health engineers assigned to the state departments of health who study and report on health problems in water plants. Dust problems particularly are subject to their scrutiny.

Safety Practices Questionnaire

On March 13, 1951, the Task Group prepared and sent to 300 towns in the country a questionnaire inquiring about current safety practices in the water works industry. The questionnaire was sent to every town having a population of 50,000 or more and to a selected group of smaller towns. A breakdown of the number of questionnaires mailed and received, by city populations, follows:

	Questionnaires	
Population	Sent	Received
500,000 and over	17	15
100,000 to 500,000	80	49
30,000 to 100,000	137	68
10,000 to 30,000	66	21
Total	300	153

The replies to the eleven questions in the questionnaire are summarized and analyzed below.

1. *Does the water utility now have an active safety program?*

Population	Yes	No	Proportion "Yes"
500,000 and over	9	5	64%
100,000 to 500,000	22	27	45%
30,000 to 100,000	27	42	39%
10,000 to 30,000	6	15	29%
Total	64	89	41%

It is indicated that the water utilities serving the larger towns are more safety-conscious than are the utilities in the smaller communities. In fact there is a direct relation between the size of towns and the practice of safety in their water utilities. Even so there is a glaring weakness in all groups. Such large cities as Boston, Buffalo, Houston, Pittsburgh and San Francisco have no safety program at all and at Chicago the program operates only at the South District Filtration Plant.

2. *Has the local water utility a full-time safety director?*

Population	Yes	No	Proportion "Yes"
500,000 and over	4	10	29 %
100,000 to 500,000	10	38	21 %
30,000 to 100,000	1	67	1½ %
10,000 to 30,000	0	21	0 %
Total	15	136	10.0%

The fifteen water utilities which have a safety director represent 10 per cent

of the towns reporting and 23 per cent of the 64 towns that have an active safety program.

3. *Has the local water utility an employee who devotes part of his time to safety work?*

Population	Yes	No	Proportion "Yes"
500,000 and over	5	6	45%
100,000 to 500,000	20	24	45%
30,000 to 100,000	25	43	37%
10,000 to 30,000	7	14	33%
Total	57	87	40%

Of the 153 utilities reporting, 37 per cent have an employee who devotes part of his time to safety work. This is a hopeful sign.

4. *Does the water utility have available the services of a city-employed safety director?*

Population	Yes	No	Proportion "Yes"
500,000 and over	9	5	64 %
100,000 to 500,000	14	30	32 %
30,000 to 100,000	14	54	21 %
10,000 to 30,000	2	19	9½%
Total	39	108	26½%

The 39 towns that avail themselves of a city-employed safety director represent 26 per cent of those reporting. Such an arrangement probably appeals strongly to the smaller water utilities. The main concern is to make fullest use of the safety director's services.

5. *Is the water utility a member of the National Safety Council?*

Population	Yes	No	Proportion "Yes"
500,000 and over	7	8	47 %
100,000 to 500,000	13	34	28 %
30,000 to 100,000	10	57	15 %
10,000 to 30,000	4	17	19 %
Total	34	116	22½%

It is surprising that as many as 34 water utilities have membership in the National Safety Council. This represents 22.5 per cent of those reporting. The task group does not believe, however, that this percentage would apply to the entire industry. It believes that a complete canvass of the smaller utilities would depress that figure considerably. The 34 water utilities included that belong to the National Safety Council are probably the approximate total for the country.

6. *Is the city a member of the National Safety Council?*

Population	Yes	No	Proportion "Yes"
500,000 and over	9	5	64%
100,000 to 500,000	22	19	54%
30,000 to 100,000	25	35	42%
10,000 to 30,000	7	12	37%
Total	63	71	47%

Membership in the National Safety Council was reported by 63 cities. The superintendents of the water utilities in these towns are by this means afforded an excellent opportunity to use the services thus made available for the protection of personnel in their departments.

7. *Has the safety program been successful in reducing accidents?*

Population	Yes	No	Proportion "Yes"
500,000 and over	8	2	80%
100,000 to 500,000	29	4	88%
30,000 to 100,000	32	10	76%
10,000 to 30,000	7	2	78%
Total	76	18	81%

The answer to this question is a resounding "yes," supported by an 81 per cent affirmation. This response would indicate that safety practices, intelligently applied, are beneficial.

8. *Are safety meetings regularly held?*

Population	Yes	No	Proportion "Yes"
500,000 and over	3	10	23 %
100,000 to 500,000	15	30	33 %
30,000 to 100,000	19	45	30 %
10,000 to 30,000	2	19	9½%
Total	39	104	27 %

In answer to Question 1, 64 water utilities admitted to having an active safety program, but in answering Question 8, only 39 indicated that regular safety meetings are held. No doubt other methods of conducting safety programs are in use.

9. *Is a safety bulletin distributed regularly to the employees?*

Population	Yes	No	Proportion "Yes"
500,000 and over	7	7	50 %
100,000 to 500,000	16	28	36 %
30,000 to 100,000	16	46	26 %
10,000 to 30,000	2	19	9½%
Total	41	100	29 %

Safety literature, especially posters, is an accepted method of keeping employees safety-conscious. This approach seems to have a distinct advantage for certain classes of employees and should not be overlooked.

10. *Does the state department of labor exercise jurisdiction over accidents in publicly or privately owned water utilities?*.

Population	Publicly Owned Yes	Publicly Owned No	Proportion "Yes"
500,000 and over	9	6	60%
100,000 to 500,000	22	23	49%
30,000 to 100,000	35	19	65%
10,000 to 30,000	5	13	28%
Total	71	61	54%

Population	Privately Owned Yes	Privately Owned No	Proportion "Yes"
500,000 and over	3	2	60%
100,000 to 500,000	6	3	67%
30,000 to 100,000	8	9	47%
10,000 to 30,000	3	4	43%
Total	20	18	53%

The returns clearly indicate that state protection of employees involved in accidents is equally applicable to publicly and privately owned utilities. This condition may have been anticipated but is proved by the survey.

11. *How many accidents were experienced in the operation of the water utility during the past three years?*

Population	Accidents per Year 1948	1949	1950	3-Yr. Avg.	No. of Workers	Accidents per Employee Yearly	Ratio of Yearly Accidents to Employees
500,000 and over	1,489	1,697	1,605	1,597	21,000	0.076	1 to 13.2
100,000 to 500,000	1,505	1,820	1,664	1,663	11,300	0.147	1 to 6.8
30,000 to 100,000	1,247	1,896	989	1,044	4,960	0.210	1 to 4.8
10,000 to 30,000	49	53	47	50	400	0.125	1 to 8.0
Total	4,290	5,466	4,305	4,354	37,660	0.116	1 to 8.6

Although the number of accidents reported in 1948, 1949 and 1950 varied somewhat, they do not appear to represent a trend in either direction. Data were not collected to determine frequency and severity rates, and it is possible that such data may not be avail-

able. If a ratio of water utility employees to the city population of 1 to 1,000 is assumed, it becomes evident that the number of accidents in the water industry does not increase directly with the population of the towns served; or, in other words, that the accident rate drops as the population rises. This relationship is to be expected because the answer to Question 1 shows that a greater percentage of the larger towns have safety programs and the response to Question 7 proves that such programs actually do produce results. It is true that the survey shows a rather low accident rate for the utilities serving the smallest population group, but this figure could be unrepresentative, and therefore misleading, because relatively few towns in that category reported.

Summary

A summary of the work of the task group shows some significant findings:

1. With some notable exceptions, the water works industry is not safety-conscious.
2. The frequency rate of disabling injuries in water utilities in 1949, as reported by the National Safety Council, was 33. This figure compares rather unfavorably with the other utilities: gas, 17; electrical, 14; and communications, 2.
3. The accident severity rate for the water works industry for 1949, as reported by the National Safety Council, was approximately equal to the national average for all industries.
4. No state reported having a safety code specifically covering water utilities. Eighteen states have "safety codes" for general construction practices.

The task group has considered these findings and has arrived at the conclusion that a sound safety program is essential in order to:

1. Reduce direct and indirect costs of accidents
2. Increase efficiency
3. Improve employee morale
4. Minimize and prevent human suffering
5. Earn public good will.

These reasons are justification enough for the adoption of a safety program, but when a national emergency is superimposed on our economy the need becomes almost imperative. The national emergency requires that manpower be conserved and that industry function smoothly and efficiently. Such requirements place added stress on safety programs.

It would appear, therefore, on the basis of the findings of the task group, that the Association might logically consider a future course of action which would include:

1. The appointment of a full committee to make a thorough study and report on personal and public safety programs now practiced in the industry, in order to learn where its strengths and weaknesses lie.
2. The development of a safety program for the industry by association, through membership, with the National Safety Council.

References

1. *Manual of Accident Prevention in Construction.* Associated General Contractors of America, Washington, D.C. (3rd revised ed., 1949), p. 234.
2. Accident Trends in the Public Utilities. Statistics & Contest Committee, Public Utilities Section, National Safety Council, Chicago, Ill. (1950).

APPENDIX

Inspection Checklist for Water Utilities

I. Supply

A. Wells
- 1. Drilling
  - a. Location safe from electrical hazards
  - b. Area restricted to authorized personnel
  - c. Dynamiting only by experienced personnel
  - d. No storage of excess explosives on job
  - e. Separate storage of explosive caps and dynamite
  - f. Safe practices in handling and storing gasoline on the job
  - g. Maintenance of rigs in good condition
  - h. Proper use and inspection of tools and cables
  - i. Measures taken to counteract fire hazards from subterranean gases
- 2. Housing
  - a. Positive ventilation to remove toxic or inflammable gases, such as hydrogen sulfide and methane, to the outside

B. Surface Sources
- 1. Submerged intake structures
  - a. Use of only experienced diver and crew for construction and inspection
- 2. Exposed intake structure
  - a. Structure restricted to authorized personnel
  - b. Adequate fence and railing guards
  - c. Experienced diver and crew
  - d. Ample lighting
  - e. Avoidance of ice hazards
- 3. Intake line
  - a. Experienced diver and crew
- 4. Shore well
  - a. Openings guarded with railings and fences
  - b. Moving parts in mechanical screens hooded
  - c. Ample lighting

II. Treatment

A. Structural Hazards
- 1. Width of walkways
- 2. Stairway guard rails
- 3. Open tank guard rails
- 4. Nonslip stair treads
- 5. Adequate headroom
  - a. In passageways
  - b. Under piping
- 6. Adequate ventilation in double story tanks
- 7. Adequate lighting

B. Mechanical Hazards
- 1. Adequate guards
  - a. On moving belts
  - b. On pulleys, gears, etc.
- 2. Equipment located in rooms inaccessible to visiting public

C. Operating Hazards
- 1. Adequate material handling equipment
  - a. Hoists
  - b. Elevators
- 2. Chemical hazards
  - a. Chlorine
    - (1) Gas masks provided, tested and maintained.
    - (2) Operators instructed in first aid procedures for chlorine exposure
    - (3) Medical assistance available
    - (4) Adequate maintenance of chlorine equipment
    - (5) Exhaust ventilation in chlorine rooms
    - (6) Neutralizing tanks for chlorine cylinders
    - (7) Proper temperature in chlorine cylinder rooms
  - b. Ammonia
    - (1) Gas masks provided, tested and maintained
    - (2) Operators instructed in first aid procedures for ammonia exposure
    - (3) Medical assistance available

(4) Adequate maintenance of ammonia equipment
(5) Exhaust ventilation in ammonia rooms
(6) Proper temperature in ammonia cylinder rooms
c. Carbon
(1) Dust masks provided and maintained
(2) Proper storage to avoid spontaneous combustion
d. Lime
(1) Dust masks
e. Alum
(1) Dust masks
f. Soda ash
(1) Dust masks
g. Fluoride
(1) Protective clothing and gloves for operators
(2) Dusts masks for operators
(3) Dust-tight dissolving and feeding equipment
(4) Rigid rules for wash-up after handling
(5) Air tests to check efficiency of precautions
(6) Urine tests of operators to check precautions
h. Other chemicals
(1) Precautions adequate to hazards involved
3. Maintenance and repair operations
a. Adequate scaffolding and safe ladders
b. Adequate hoisting equipment
c. Sufficient and proper tools
d. Eye shields
e. Adequate light
4. Filters
a. Screen over waste water discharge
b. Safe ladders for access in cleaning settling basins and clear wells

D. Laboratory
1. Fire extinguishers
2. Fume hood in good condition
3. Safe gloves and clothing for handling acids
4. Precautions during and after handling cultures

III. Pumping

A. Structural Hazards
1. Width of walkways
2. Stairway guard rails
3. Nonslip stair treads
4. Adequate headroom
a. In passageways
b. Under piping
5. Adequate lighting

B. Mechanical Hazards
1. Adequate guards around moving parts of equipment
2. Nonslip floors
3. Gasoline and oil pipelines well protected

C. Operating Hazards
1. Adequate pressure gages and alarms
2. Geared valves for ease of operation
3. Switchboards well guarded and grounded
a. Rubber gloves for high-voltage switch operation
b. Rubber mats on floor at switchboards
4. Steam pressures under good control
a. Adequate safety valves
b. Frequent boiler inspection
c. Water level alarms on boilers
d. Well maintained gages
5. Gasoline and diesel engines
a. Fire extinguishers (CO_2) at hand
b. Adequate starting equipment
6. Maintenance and repair operations
a. Adequate scaffolding and safe ladders
b. Adequate hoisting equipment
c. Sufficient and proper tools
d. Eye shields
e. Adequate light

IV. Storage

A. Ground Level Storage
1. Adequate fencing to keep out public
2. Frequent inspection and adequate structural maintenance
3. Maintenance of safe access ladders and railings

B. Elevated Storage
1. Adequate means of preventing unauthorized climbing
2. Well protected access ladders and hatches

3. Adequate ventilation during cleaning
4. Proper lighting
5. Frequent inspection and adequate maintenance of structure and ladders

V. Distribution System

A. Water Main and Service Line Construction, Leak Repair, Hydrant and Valve Repair
  1. Safe construction machinery
  2. Pipe handling
    a. Unloading from cars
      (1) Adequate power crane
      (2) Safe and adequate slings
      (3) Safe blocking in truck or trailer
      (4) Criss-cross layer stacking if piled in storage
    b. Placing along trench
      (1) Mobile power crane for unloading from carriers
      (2) Safe and adequate slings
      (3) Bells in laying direction to avoid turning later
      (4) Safe blocking to prevent rolling
    c. Placing in trench
      (1) Mobile power crane
      (2) Safe slings
      (3) Men out from under
    d. Pipe and fitting installation
      (1) Safe lead melting furnaces
      (2) Adequate gloves and clothing
      (3) No wet joints
      (4) Adequate and proper hand tools in good condition
  3. Trenching
    a. Sheathing and shoring adequate to type of soil and trench size
    b. Ground water
      (1) Pumps of adequate capacity
      (2) Well points if necessary
    c. Other utilities
      (1) Prelocation of sewer, gas, electric and telephone conduits to avoid cutting
      (2) Hand excavation to locate if exact position uncertain
    d. Loading of trench banks
      (1) Excavated material deposited safe distance from trench
      (2) Heavy machinery kept back from trench edge
      (3) Materials placed back from trench edge if of considerable weight
      (4) Adequate protection against caving provided in conjunction with sheathing and shoring
    e. Public protection
      (1) Adequate barricades
      (2) Adequate warning lights
      (3) Adequate warning signs placed sufficiently far ahead on approach to site of construction
    f. Backfilling
      (1) Thorough consolidation of backfilled material
        (a) tamping
        (b) puddling
      (2) Maintenance of warning signs and lights until permanently safe
      (3) Daily inspection, repair of rough spots, sink holes
      (4) Replacement of permanent surface as soon as practical

B. Leak Exploration
  1. Warning signs and flags to slow traffic
  2. Barricades

C. Hydrant Flushing
  1. Warning signs, flags and barricades to slow or divert traffic as necessary
  2. Barricades

D. Main Sterilization
  1. Protective clothing and gloves if required by agent used
  2. Gas mask if liquid chlorine is used

E. Service and Main Thawing
  1. Precautions to prevent fire in dwellings

VI. Meters and Services

A. Handling Large Meters

B. Setting of Meters

C. Service installations
  1. Shoring of ditch where necessary
  2. Objects being kept away from edge of ditch

3. Use of necessary safety devices
   a. Goggles
   b. Safety shoes (pick injuries)
   c. Gloves
4. Barricading and lighting
5. Encountering of other utilities

VII. Reading Meters and Billing

A. Reading Meters
1. Condition of stairs and ladders
2. Proper ventilation if meters are in vaults
3. Precautions against injury by animals or insects
   a. Dogs
   b. Spiders, scorpions or insects
   c. Snakes
4. Manhole covers on meter pits
5. Use of flashlights to guard against overhead obstructions

B. Billing Operations
1. Proper guards on addressing machines
2. Proper guards on billing machines

VIII. Machine Shops and Garages

A. Machinery and Equipment
1. Proper guarding of moving parts
2. Regular inspections
   a. Mechanical condition of machinery
   b. Condition of ropes, hoists, hand tools, compressors, and welding and other equipment
3. Proper lighting around machinery
4. Emergency stop switches

B. Housekeeping and Sanitation
1. Posting of necessary warning signs
2. Proper housekeeping
   a. Clean floors
   b. Unobstructed passageways
3. Provision of proper fire extinguishers
   a. Electrical fires
   b. Gasoline and similar fires
   c. Other types of fires
4. Proper ventilation to prevent accumulation of hazardous fumes
   a. Carbon monoxide
   b. Explosive vapors
5. Storage and waste disposal
   a. Proper storage of gasoline and other dangerous substances
   b. Proper disposal of oily rags, dangerous wastes
6. First aid
   a. Properly equipped first aid kits
   b. Instructions and training in first aid
7. Proper washroom facilities and lockers

IX. Automotive Equipment

A. Maintenance and Use of Safety Equipment
1. Brakes
2. Rear-view mirrors
3. Chains
4. Stop lights
5. Windshield wipers
6. Other equipment

B. Condition of Critical Equipment
1. Tires
2. Steering apparatus
3. Wheel alignment
4. Exhaust pipes
5. Other equipment

C. Loading
1. Proper placement and securing of loads
2. Avoidance of overloading

D. Instructions to Drivers
1. Safe driving
2. Transporting of men
3. Other considerations

X. Construction Equipment

A. Machinery
1. Regular and thorough inspection of all machinery (shovels, motors, hoists, cranes, bulldozers, boilers, engines, compressors, pumps and lighting equipment)
2. Maintenance in proper mechanical condition

B. Other Apparatus
1. Regular and thorough inspection of other apparatus (cables, ropes, hooks, rings, guys, control apparatus, and electrical equipment and controls)
2. Maintenance in proper condition

C. Proper Operation
1. Avoidance of overloading
2. Use of equipment only for purposes for which designed
3. Proper operation on streets and highways

XI. General Construction

A. Machines and Transmission
1. Provision of guards
 a. Belts, chain and rope drives
 b. Gears, sprockets, pulleys
 c. Shafting, set screws, collars, clutches
 d. Saws, jointers
 e. Grinding wheels
 f. Punch presses, hammers
 g. Other operating machines
2. Condition of guards:
 a. Off
 b. Defective
 c. Unsatisfactory to operator
3. Hazard of being caught by machinery
 a. Revolving parts
 b. Shear points
 c. Travel of machine (planer)
4. Slippery floor at machine
5. Counterweight dropping if cable breaks
6. Fatigue failure of part subject to vibration
7. All parts safely accessible for oiling and other servicing
8. Emergency stops
9. Lighting
10. Ventilation (if fumes present hazard)

B. Regular Inspection of Boilers, Engines, Compressors, Pressure Wheels, Oxy-acetylene and Electric Welding Equipment

C. Hoisting Apparatus
1. Proper condition
 a. Chains, ropes (see Sec. XI–D, below)
 b. Hooks, rings
 c. Brakes, dogs, locks
 d. Sheaves and pins
 e. Guys and braces
 f. Control apparatus
 g. Emergency stops and catching devices
2. Proper oiling of apparatus
3. Limit stops
4. Emergency stops, catching devices
5. Guards for wheels, cables and the like
6. Protection of engineer or craneman
7. Guards to keep persons away
8. Footwalks, railings, toeboards, ladders
9. Standard signaling system
10. Elevator hoistway gates or doors

D. Chains and Ropes (Hoisting and Other)
1. Overloaded
2. Excessive wear or stretch
3. Kinked, frozen, untwisted
4. Condition of splices or joints
5. Proper care and inspection
6. Availability of sufficient variety of sizes, spares
7. Methods of attaching

E. Electrical Equipment:
1. Grounding
2. Insulation mats
3. Guard or enclosure; danger signals
4. Clearance; slipping hazard
5. Condition of switches and locks
6. Fuses
7. Understanding of hazards and emergency procedures by operators
8. Fire hazard from overheating, short-circuit or spark
9. Electric wiring
 a. Wire strung on nails
 b. Portable cords
 c. Outside wiring; poles, cross-arms

F. Gas and Other Heating and Lighting Equipment
1. Fire hazards
 a. Walls
 b. Ceiling
 c. Floor
2. Condition of chimneys and flues
3. Explosion hazards
4. Asphyxiation hazards, including carbon monoxide

G. Ladders, Stairs, Runways, Platforms, Floors
1. Worn places, cracks
2. Loose boards or rungs
3. Slippery places
4. Protruding nails or splinters
5. Railings
6. Slipping of ladders
7. Uneven spacing of rungs or steps, uneven floors
8. Lighting
9. Floor openings
 a. Railings

b. Toeboards
c. Material piled too closely

H. Hand Tools
1. Dull
2. Mushroom heads
3. Split or loose handles
4. Unsuitable for work
5. Special hazards of pneumatic or electric tools

I. Wheelbarrows, Trucks, Cars
1. Condition
2. Sufficient number
3. Suitable for work
4. Size and capacity
5. Handle guards
6. Hopper dump cars

J. Goggles, Masks, Respirators, Gloves, Aprons, Shoes and Other Safety Accessories
1. Provision of proper type
a. Effectiveness
b. Comfort in use
2. Used by men
3. Condition
4. Wearing of loose clothing

K. Piling and Handling Materials
1. Proper piles
2. Loading and unloading methods
3. Danger of cave-in
4. Maintenance of passageways

L. Compressed Gas, Chemicals, Explosives, Hot Substances
1. Containers
2. Pipelines
3. Fire hazards
4. Splash hazards
5. Corrosion hazards

M. Housekeeping
1. Passageway maintained
2. Projecting nails
3. Objects to slip or stumble on; oily places
4. Rubbish; oily waste
5. Scrap or old material to be sold or reclaimed
6. Waste containers
7. Dust accumulations (explosion hazards)

N. Yards and Buildings
1. Snow and ice
2. Falling icicles
3. Drainage
4. Walkways
5. Vehicle collision hazards
a. Railroads
b. Motor vehicles
c. Hand trucks
d. Pedestrians
e. Any combination
6. Railroad crossings
a. Good condition
b. Guards, signals
7. Safe car switching
8. Clearance between tracks and structures
9. Strength of trestles, tanks and buildings
a. Settlement
b. Dry rot
c. Cracks
d. Corrosion
e. Vibration
10. Condition of cornices, copings, skylights, chimneys, signs and flagpoles
11. Danger points
a. Ditches
b. Holes
c. Poles
d. Wires
e. Obstructions
12. Lighting

O. Quantity and Condition of Fire Protection Equipment
1. Sprinkler heads
a. Condition
b. Obstructions
2. Sprinkler valves
3. Extinguishers
4. Pails and barrels
5. Hose, hydrants
6. Escapes
7. Exit doors and passageways
8. Regular fire drills

P. Sanitation
1. Toilets
2. Washrooms
3. Locker and dressing rooms
4. Ventilation
5. Lighting

Q. First Aid Equipment
1. Condition
2. Understanding of use
3. Reporting and treatment of slight injuries

Administration of the Ground Water Law of New Mexico

By John H. Bliss

A paper presented on September 28, 1950, at the Rocky Mountain Section Meeting, Santa Fe, N.M., by John H. Bliss, State Engineer, Santa Fe, N.M.

NEW Mexico has been one of the pioneers among the arid western states in exercising jurisdiction over ground waters. For many years a somewhat hazy picture of ground water control and administration was drawn by the courts of several states passing on ground water cases. In general, the courts treated water beneath the surface of the earth as an unknown quantity which moved at random in vagrant channels, presenting a problem which was difficult, if not impossible, to control by law. The increasing importance of ground water, not only in the western states, but throughout the country, has resulted in a notable advance in our knowledge of ground water principles. As stated by Thompson and Fiedler of the Ground Water Branch of the U.S. Geological Survey (1): "There is [a] definite recognition of the fact that ground water is no longer a hidden resource whose mode of occurrence, movement and extent is mysterious and indeterminable, but . . . on the contrary [that] these properties are definitely ascertainable by scientific investigation."

Pecos River Basin

Just before the turn of the century, settlers in the Pecos River basin near Roswell, N.M. discovered flowing artesian water relatively close to the surface. Because the water in an area of 660 square miles lying west of the Pecos River seemed almost limitless at the time of discovery, irrigated agriculture from wells developed rapidly. Not until 1915 did it become apparent that the supply under artesian pressure was limited. Many wells in outlying areas of the basin ceased to flow. By the early 1920's about one-third of the original area had dried up and in 1931 all new artesian developments in the basin were stopped by the State Engineer, following the passage of an underground water law. Prior to 1926, there had been little significance attributed to the shallow ground waters of the basin which overlie the artesian water and which are largely fed from that source. From 1926 on, however, the pumping of shallow ground waters developed so rapidly that in 1937 the State Engineer ordered the shallow water area closed to further development.

About 1925, the state arranged with the Ground Water Branch of the U.S. Geological Survey for a cooperative study of the Roswell basin to determine, among other matters, the source of the ground water supply and the probable amounts available for use. The purpose of the study was to make recommendations for control which would permit a stable economy to be estab-

lished within the basin and which would protect the rights of existing water users from further encroachment. With the completion of the report (*2*), the limits of the basin were determined and recommendations were made.

Ground Water Law

As early as 1912, some control of artesian water had been placed in the hands of the individual counties; this regulation of water development and use was found to be ineffective, however, and in 1927 a state underground water law was passed. Because the Supreme Court declared this law unconstitutional on technical grounds, a revised law was passed in 1931 which recognized beneficial use and priority of appropriation of ground waters. It declares that all underground waters of the state having reasonably ascertainable boundaries belong to the public and are subject to appropriation.

The State Engineer has, from time to time, found it necessary to make determinations of the reasonable boundaries of water basins to assure their orderly development and control. Boundaries of other areas in which administrative control of public waters has not been found necessary have not been so delimited. In the determination of basin boundaries, the state has leaned heavily on the technical advice and findings of the Ground Water Branch of the Geological Survey. Cooperative agreements with the Geological Survey provide for the investigation and water measurement of its several basins. Potential water supplies in each basin and other pertinent data are thus determined. The survey also periodically measures test wells in each of the basins to determine ground water changes, thus helping to assess ground water use. Should a basin approach optimum development, the services of the agency are available to help the State Engineer decide whether further appropriations should be either curtailed or stopped altogether.

In defining ground water basins, the State Engineer and the survey do not endeavor to follow the geologic limits of a basin since such determination is not necessary for the proper administration of the law. The original boundaries of the Roswell artesian and shallow water basin, as delineated by the State Engineer in 1931, included only those lands on which water could be reached at a depth of 50 ft. or less from the surface although it was recognized that a considerably larger area than this was underlain with ground water. Over the years, as the value of land and crops increased and the efficiency of pumps improved, it became necessary to extend the original limits of some of the basins. The Roswell Basin, for example, was enlarged no less than six times and the Mimbres Basin in southwestern New Mexico, twice.

Approximately a year ago, the New Mexico Bureau of Mines and the State Engineer's office in cooperation with the Ground Water Branch of the Survey began a geologic and ground water survey of the entire state by counties. It is estimated that the study will take several years to complete; however, it should add immeasurably to our knowledge of the state's underground water supplies: their occurrence, quantity, quality and other pertinent data.

Although departing from it in certain necessary respects, New Mexico's ground water law is modeled on its surface water code. As an essential part of his administrative duties, the State Engineer is charged with defining the

boundaries of the state's ground water basins. If the waters of such basins are declared to be public and thus subject to appropriation, the State Engineer will accept for the record all water uses existing at the time the basin is declared. Such rights are recorded in his office with the filing of a declaration of right, setting forth ownership, the location of the well, irrigated acreage, initial date of use and other essential data. All subsequent rights must be obtained after approval of applications to appropriate. Such applications follow the regular appropriative procedure. By law, the State Engineer must pass upon each application to determine whether unappropriated water is available for use. If the owners of adjacent lands feel that their water rights are jeopardized by the proposed new use, they may protest its approval. In such disputes, the State Engineer must render a decision, following hearings, either granting or denying the application. Appeals from his decision may be taken by either party to the District Court.

The New Mexico law has worked satisfactorily during the nineteen years of its existence. The code is relatively flexible, giving the State Engineer rather broad powers of administration and control. He has established procedural regulations governing features of administration not specifically set forth in the law. The code has been amended several times to provide for better and more equitable administration and appears to face further amendment as certain questions raised in the past few years may require clarification by the legislature or the courts.

Administration

Unlike surface waters, the amount of underground water which is to be found in any basin available for appropriation is not quickly and readily determinable. It is difficult for most people to understand why they cannot use water under their own lands when the water appears to them to be ample in supply; they see no reason for not being able to use "their share." Many feel that each landowner should have the right to use what water he can draw from his own land, overlooking the fact that such supply may be limited and fully appropriated by prior users.

A difficult administrative problem is that of determining when further appropriations would be detrimental to existing rights in a basin or any portion of a basin. The criterion applied by earlier State Engineers was that consumptive use should not exceed the average annual recharge of the basin. This criterion, however, does not always result in the best possible use of the available supply.

Many shallow water basins occur in areas of limited rainfall where the annual recharge is small. If irrigation development is limited to the annual recharge of such basins, the best and most economical use of the water supply will probably not be achieved. Areas which have accumulated ground water supplies over thousands of years may be largely depleted within a relatively short space of time, geologically. It must be determined, therefore, how much development should be permitted and how fast these reservoirs should be dewatered. In the high plains areas of New Mexico and Texas, for example, surface conditions are such that ground water infiltration is almost nonexistent. Once the ground water is depleted in these areas, it cannot be replaced for many generations. Although this is not true of some areas of New

Mexico, the recharge is so limited in most of the basins that the practical effect is the same.

In his administration of the law, the State Engineer has treated surface and ground waters as separate and distinct sources of supply. In many areas, however, no such separation actually exists. When the Roswell area was first settled, there were large springs in the northern part of the basin which acted as natural relief valves to the artesian basin; these surface waters were quickly appropriated by the settlers. The development of the artesian supply through wells has so decreased the artesian head, however, that these springs have either ceased to flow or have greatly decreased in size. As a result, many of the holders of the earliest surface water rights in the area have found yields severely reduced and some developments have been entirely abandoned. Under the present policy of the State Engineer's Office, with the basin closed to further appropriation, holders of such surface water rights are precluded from obtaining relief from the same ground water sources which originally fed their surface supplies. Use of such sources by others is the chief cause of their difficulties.

In the Carlsbad Basin, which was placed under administrative control in 1947, the State Engineer has permitted applicants to drill wells and appropriate ground water to supplement existing surface supplies, but has denied applicants the right to develop new irrigated areas. The water supply of that basin is so limited that irrigation of new lands from this source was felt to be detrimental to existing rights. The use of ground water to supplement existing surface rights is permitted on the theory that surface water use contributes to the ground water supply and therefore that water right users have the right to draw on such ground water storage in years of deficient surface supply.

The Pecos River Compact governing the allocation of waters between New Mexico and Texas provides that: "New Mexico shall not deplete by man's activities the flow of the Pecos River at the New Mexico-Texas state line below an amount which will give to Texas the quantity of water equivalent to that available to Texas under the 1947 condition." It further provides that: "In maintaining the flows at the New Mexico-Texas state line required by this compact, New Mexico shall in all instances apply the principle of prior appropriation within New Mexico."

In a state of nature, the Roswell artesian and shallow water basin contributed large quantities of water to the base flow of the Pecos River. With the development of wells in the area, this base flow has been greatly reduced. The ultimate effect of ground water uses on the river will not be evident for many years to come. Should it be such that the flow at the state line is decreased by man's activities, below the 1947 condition, the State Engineer's only recourse would be to require the junior appropriators—the ground water users in the Roswell Basin—to cease their use of water. The result of such a reduction in pumping would be reflected in the river flow only after a considerable period of time and would offer no immediate solution to this knotty problem.

Best use of the available supply of any ground water basin, all other things being equal, calls for the uniform spacing of wells throughout the area. Such a procedure will insure the longest use of the available supply

and the smallest drawdown of water throughout the basin. Under the New Mexico law, this ideal utilization cannot be obtained because applications must be processed in the order in which they are received. As a result, development is concentrated in areas of better-yielding wells and of better lands. Thus some areas of a basin tend to become overappropriated while others with less desirable lands or poor water supplies are hardly touched. In the Mimbres Valley area, for example, the water supply for lands in the upper part of the basin, around the town of Deming, has been fully appropriated. In the southern part of the basin, however, there may be large areas where additional pumping could be permitted with little detriment to prior appropriators. In attempting to cope with this problem, at one time the State Engineer established more or less arbitrary boundaries around certain areas in the basin within which no new appropriations were permitted. The procedure did not work very well, particularly in areas close to the boundaries, with the result that it was discontinued and the entire basin closed to further development. It would be desirable if some workable formula could be reached which would permit continued appropriations in areas of light development but not in areas where water uses have reached their optimum. To date, the State Engineer's office has not found any formula which seems acceptable.

Under that section of the law which provides for administrative determination of public waters available for appropriation, the State Engineer has assumed the authority to close part or all of a basin in which he judges the ground waters to be fully appropriated. There is some question whether he has the authority to make such determinations on a basin-wide or area basis, or whether each right must be determined separately on its individual merits.

Another problem presented to the administering authorities involves the moving of rights from one tract of land to another. Under New Mexico law, this may be done only with the approval of the State Engineer. A question arises which apparently was not considered by the legislature at the time the law was passed: Should the state permit the transfer of rights away from areas of failing water supply to avoid forfeiture of those rights; or, if the wells in congested areas fail because of the dewatering of the aquifers, will these lands eventually be dried up and the water rights forfeited? It is possible to move some of these rights to less congested areas but often the change involves a move of several miles and an appropriation of what is in effect additional water in the new area.

These problems, as well as others encountered by the New Mexico State Engineer in his administration of ground waters, do not decrease; on the contrary, they seem to grow in number and importance with the growth and development of the state's underground supplies.

Since the cessation of hostilities in World War II, there has been a tremendous increase in ground water development all over the state. At present, nine basins within the state are defined and are being administered by this office. There are others which are developing rapidly and which may soon be defined and brought under control. Several of the basins have already been closed to further appropriations because they have reached the practical limits of development. Be-

cause of increased returns from irrigated agriculture, many farmers, particularly in the closed basins, have been tempted to violate the law and irrigate more acreage than the amount to which they are entitled. In the Roswell Basin, it has been estimated that almost 10 per cent of the acreage irrigated in 1947 and 1948 was watered illegally. The violations have varied in severity from the action of the farmer who adds two or three acres to his allotment by squaring up his field, to that of the violator who has drilled new and illegal wells and brought in considerable areas of new lands. The state is now checking underground water rights in the several basins, and bringing whatever violations are found to the attention of the courts. The State Engineer's office has had considerable success in obtaining injunctions against violators and it is believed that illegal uses can be considerably reduced in the near future. The larger question of whether or not the law is constitutional, however, will determine the pattern of future control measures.

Constitutionality

A test case to determine the constitutionality of the entire ground water law is now being prosecuted in the New Mexico courts. About two years ago this case was first introduced in the District Court in Chaves County as a result of injunction suits brought by the state. The court rendered a decision upholding the State Engineer in almost all of the questions raised in the suit. Recently the case was heard on appeal by the Supreme Court of the state, which upheld the decision of the lower court. The plaintiffs have appealed the case to the U.S. Supreme Court, and a decision is pending.

Because millions of dollars of land and property values are intimately affected by the underground water law, the law has become what is legally termed a "rule of property." It has been recognized by many as an example of desirable state control of ground water resources and the author feels that the state stands on relatively firm ground in the current test case. On the other hand, all of the basic principles which should govern ground water administration are not yet fully fixed and determined. The State Engineer's office is still "feeling its way" in certain phases of administration and it will probably be some years before the answers are obtained to some of the questions posed in this paper. Some may never be answered to everyone's satisfaction, but the author believes that a good start, at least, has been made.

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Local and Regional Water Supply Management

By Harry E. Jordan

A paper prepared for presentation on May 2, 1951, at the Annual Conference, Miami, by Harry E. Jordan, Secy., American Water Works Assn., New York.

GOOD water supply management is the point of this discussion and by "the point" is meant the body of practice which involves, first, leadership in the development of water systems for towns, cities and regions and, second, the maintenance and operation of such systems honestly, efficiently and with adequate engineering foresight, all in the public interest. In the discussion, consideration will be given to the modern methods which have been found successful in bringing water supplies to American cities and regions, but no attempt will be made to deal with such specific components of the system as its dams and reservoirs, its pumps and pipelines, its service pipes and meters. Although meters are mentioned specifically, they are discussed not because they are a necessary component of any well designed water system, but because they are an important tool of good management.

Before embarking on the discussion, the author wishes to point out that the opinions expressed here are based upon his own personal judgment. The facts and figures are taken from published records of the various agencies mentioned.

Types of Organization

Historically, the great majority of water works have been developed for single communities or closely adjacent groups of towns. The traditional small-town publicly owned water system is an integral part of the town's government, controlled by the council or the town board. In such a system, water charges are ordinarily paid into the city treasury and needed funds appropriated by the council, no specific identity being given to the water system in the accounting system. For the very smallest towns, this lack of administrative and financial identity may be excused. For any water system serving more than 1,000 persons, failure to identify administrative funds and indebtedness of the water system cannot reasonably be defended. For cities as large as New York and Philadelphia to collect all water income at the city treasury and to require the water works management to obtain operating and maintenance funds through annual appropriations by the council is archaic.

In many cities—both large ones, such as Los Angeles and Detroit, and small ones, of which there are hundreds—the water utility has been set up under control of a water board or commission, appointed in such fashion as to be free from political currents and charged with administering the water system as an integrated public business enterprise. Wisconsin offers a conspicuous example of intelligent utility legislation, requiring the creation of water boards for city owned systems, the segregation of water works funds

and the placing of municipally owned utilities under the control of the public service commission. Not only in Wisconsin but in many other states, as well as in various provinces of the Dominion of Canada, the commission or board control of publicly owned utilities is recognized as a superior method of operating such enterprises.

In communities where the city-manager form of government is in effect, the water system generally operates under a department head who is subject to administrative control by the manager. To the extent that the manager form of local administration produces results which are superior to the general level of city administration in the region, the loss of identity of the water utility may be compensated for by the other virtues of the manager plan. But even in a manager type city, the board or commission type of control of the water utility is likely to produce better results for the water utility and for the people served.

About one-fifth of the water systems in the U.S. are privately owned and operated and four-fifths publicly owned. One hundred years ago the proportion was reversed.

In many small towns and cities, after the war between the states had ended, citizens began to feel the need of public water supply. Generally the leading banker and a few of the citizens formed a "company" and built a water works, simple in design and limited in service area. As the towns rapidly grew to cities, the private owners were often unable or unwilling to add the capital to make the needed extensions. The city then took over the property and bonded itself to fund the improvements. And during the past fifty years, preferential tax policies favoring publicly owned properties and advantageous interest requirements for municipal bond issues have also served to simplify the problem of expanding municipal ownership.

There are still a number of the larger cities where privately owned water systems continue to operate with satisfaction both to the public served and to the owners. Cities such as Birmingham, Indianapolis, Wichita, New Haven, Bridgeport and groups of cities such as are served by Hackensack Water Co., Philadelphia Suburban, St. Louis County, California Water Service, Southern California Water Service, American Water Works, have under postwar conditions reaped the benefits of aggressive planning and extension policies.

There is no point in philosophizing on public *vs.* private ownership in the water works field. From the standpoint of development of property in the interest of the water users, between the well managed publicly owned utility and the well managed privately owned property there is no difference in progressiveness. There are examples of laggard management under both public and private ownership.

Investment in Water Works

An average figure of \$60 per person may be taken as the pre-World War II general cost of water works in the United States. The extensive reservoir and aqueduct systems of Los Angeles and New York bring the per capita investment in those cities up to about \$100 per person. The total cost of installed water systems serving 94.4 million persons in 1945 was more than $5\frac{3}{4}$ billion dollars. Postwar construction costs (1949) were nearly 100 per cent higher than immediate prewar (1939) and 50 per cent higher than immediate postwar (1945) costs, with

evidence, historically grounded upon previous postwar price experiences in U.S., that a recession to 1939 price levels will not occur. It is generally assumed by engineers that future costs of water works, as a unit, will range from $100 to $125 per person served. In this context, it is interesting, too, to note that the capital investment in water works during the past 25-year period has proceeded at 2½ times the rate of population increase.

Funds for maintenance of water systems and, to some degree, for extensions are derived from surplus revenues. As is shown later in the discussion of Pennsylvania authorities, indenture requirements are sometimes such as to require that the complete cost of a water system be liquidated by revenues within 40 years.

Any properly designed and operated water supply system can pay its way and expand itself in step with community growth. It is a fallacy to proceed upon the principle that a community's water supply system cannot be funded from the revenues paid by the water users. Rather bluntly it may be said that any sizable community that cannot afford to build a water works system and pay for it is so uneconomically located as to justify the relocation of its citizens in some other place.

Massachusetts Metropolitan Water District

The recent series of regional or district developments evidences a constructive trend in public water supply and, in the light of the national interest in more adequate supplies for municipalities, is the focal point of this discussion.

Without attempting to ascertain where the first purely "regional" water system was set up in the United States, the Massachusetts Metropolitan system may be first considered for the purposes of this discussion. Its program was initiated in 1895, when the state legislature authorized the creation of the Massachusetts Metropolitan Water District for the purpose of constructing works to supply Boston and cities and towns within a 10-mile radius of the State House in Boston.

In studying this development it must be remembered that Massachusetts policy in state-city relationships is unusual, for the legislature continues to consider and enact laws on matters which in a majority of states have been relinquished to the cities and towns under local laws. Often, authorization of extensions to local water systems, which would elsewhere be controlled by some such body as the "Public Service Commission" or the "Conservation Commission," require a special act of the legislature. In other words, Massachusetts had long been accustomed to doing things at the state level which would, in other states, be done (if at all) by cities and towns. Thus it was no strain upon the public imagination for Massachusetts, when the Boston metropolitan area saw water supply problems ahead, to authorize a "state" water supply system.

The novelty of the Massachusetts development lies in the fact that the 1895 act set the state up in the water business as wholesaler. The Metropolitan Commission does not act as a retail agency, but stops at the city or town line and there sells water to a local utility, which carries on from that point in the conventional manner of water utilities. The phrase "stops at the city line" is subject to two very important limitations. The commission is authorized by the basic act to control water waste in its customer

towns. It is also authorized to control, by approval or disapproval, the minimum rates charged for water by any customer town. The act also set up certain basic stipulations concerning the financial transactions of the various commission-supplied water departments which require good business administration of the local water system, up to the point of protecting water works earned surplus revenue against its diversion to other public uses. The investment in the Metropolitan system approximates 100 million dollars. In 1950 it served 23 towns with estimated total population of 1,670,000. Water sold in 1949 averaged 190.92 mgd. or 115.2 gpcd.

The Massachusetts Metropolitan Commission, its works and its operations represent a conspicuously successful method of meeting the water supply needs of a densely populated metropolitan area, overriding the municipal boundaries and establishing a quasistate authority to develop and sell water at wholesale. Whenever the bonding power of a state permits or whenever an authority can legally be established under state law (as for the Pennsylvania and the New Jersey turnpikes) the same policy can be put into effect in any state—*if the economics of the development make the bonds salable.*

New Jersey "Home Rule"

New Jersey has approached the problem of regional water supply in a different fashion, its approach likewise being conditioned upon the pattern of state-local relationships embedded in the history of the state. Just as Massachusetts has held to the "Commonwealth" the right to legislate upon items of local concern, New Jersey has for many years had city-town acts which confer extensive home rule powers upon incorporated communities. The trend to "incorporate" a small community as a named local unit of government has been widespread. Whatever else may be said about this New Jersey characteristic, the multiplicity of small, independent units of government does not make for rapid and effective solution of regional water problems.

New Jersey has set another limitation upon its own ability to follow the Massachusetts pattern. The state is limited in its permissible debt to "not more than one per cent of the total appropriation [of funds by the legislature] for the preceding year." In 1950 this set a limit of $1,500,000 upon the total debt of the state. Massachusetts Metropolitan bonding authority, granted by the legislature, totaled nearly $100,000,000—an amount which, under New Jersey law, would be far beyond the constitutional debt limit of the state. Thus, under New Jersey conditions, when the industrial part of the state above Mercer County had a serious water supply problem, recognized as requiring concerted action, the 1916 legislature authorized the creation of water districts, the formation of which required the governing body of each municipality interested to petition the governor to appoint a commission under the terms of the act.

To date only one such district—the North Jersey District Water Supply Commission—has been established. Under the terms of the act, eight municipalities—Newark, Paterson, Passaic, Clifton, Kearny, Montclair, Bloomfield and Glen Ridge—have each assumed a share of the debt obligation related to the development of Wanaque

Reservoir and the related supply lines, pumping stations and other facilities involved. The total cost of the "North Jersey" works constructed up to 1950 was approximately $31,000,000.

Twenty municipalities receive all or a part of their supply from Wanaque Reservoir. The average daily draft upon the system in 1949 was 91.5 mgd., about 6.5 mgd. above the estimated safe yield of the system. Although that does not evidence as satisfactory a set of conditions as that of the Massachusetts Metropolitan system, the differences are not derived from errors or omissions at the broad engineering level nor at the local water utility management level. Rather they stem from the concepts and practices in the field of state-local relationships, which limit New Jersey's ability to do the things of regional value that can be done in other states. Under Massachusetts law and procedure, North Jersey by 1950 could easily have achieved a reasonable solution of its water supply problems. Perhaps the lessons of the 1949–50 water shortage will convince political leaders in the state that changes in policy are in order.

Recent legislation permitting the establishment of "authorities" in New Jersey has not yet been applied to water works development. If it is, such legislation may serve to improve conditions where group or regional development is needed.

Pennsylvania "Authorities Acts"

Pennsylvania legislators, in 1935, took the first steps toward enactment of the "authority" act, under which 71 water works ownership and management groups were functioning in 1950. The series of legislative enactments known as the "authority acts" permit the citizens of a single city or town or of groups of incorporated and unincorporated places to establish an agency through which governmental units may provide needed facilities and services for themselves, upon a self-liquidating basis, in the manner of private industry and without obligating the pre-existing units of government. Such an authority is authorized to file liens for debts owed, is given the power of eminent domain—but not to acquire a water works or other system by condemnation—can sue and be sued, and can issue revenue bonds, but may not obligate the municipality. The life of an authority under the Pennsylvania acts is limited to 50 years, while bond issues are limited to 40 years, with maturity of refunding bonds restricted to the life of the authority. At the termination of the life of an authority, its property may revert to the municipality or municipalities which incorporated it. One further stipulation, which is of great value, requires that, for the period during which authority revenue bonds are outstanding, an engineer must be retained by the authority to advise it on matters of planning and management.

Authorities have been given the power to assess benefited properties for the cost of improvements in proportion to the benefits received, giving them, in this respect, an advantage over private companies. They must establish a rate structure that will make them entirely self-supporting from revenues or rentals. They are permitted no other sources of income and may not be parasites on any municipal funds, except, possibly, when a system is leased back to the municipality for op-

eration. On the other hand, authorities cannot be deprived of their revenues to carry out other municipal functions.

The populations served by various Pennsylvania water authorities in 1950 varied from 700 to more than 100,000. By the end of 1947, 65 water authorities served more than 1,300,000 consumers and the total assets of the group were in excess of $101,250,000.

The Pennsylvania authorities represent an approach to the problems of regional or group development of water supply which differs considerably from the patterns of Massachusetts and New Jersey. For the conditions in Pennsylvania and most other states, the "authority" plan is superior to other methods of group action. It should be noted, however, that what is called an "authority" in Pennsylvania may be called a "district" in other states.

Maryland Metropolitan Districts

In Maryland, where a number of fine water districts are to be found, there operates the Washington Suburban Sanitary District, in many ways the nation's best example of group action in community services. It is not only a water supply agency, but builds and operates sewers and sewage treatment systems, collects and disposes of garbage, and controls all plumbing in its service area.

The district was established by a 1918 act of the Maryland legislature, modified since, from time to time, as experience indicated the necessity.

The commission in charge has been given all the usual powers of a Maryland municipality in the fields of water supply, sewerage, storm drainage and refuse collection. It may issue bonds as required, *without referendum.* It prescribes the amount of tax and frontage charges assessed by the county commissioners against property abutting its water lines or sewers. It fixes and collects the service rates charged against users of water and other services.

At the time that the Washington Suburban was established it served a 95-square mile area; by 1947 it served 198 square miles. In the area since 1918 there has been a residential and business expansion hardly paralleled anywhere in the East. In 1947 the district served more than 200,000 persons and its assets exceeded $29,000,000. The organization has pulled itself up by its own bootstraps, financing its developments by sales of bonds which have found and continue to find a ready market among bond buyers.

The property is skillfully engineered and managed. In thirty years, it has sextupled its total of customers served, without subsidies or grants-in-aid, clearly demonstrating that regional needs for water supply can be met on the credit of the region, if intelligent planning and good management are applied to the program.

Southern California District

The preliminary releases of 1950 census data show that, in the past ten years, California gained more than 3,500,000 inhabitants, or 51.6 per cent of its 1940 total. Whatever else may have contributed to this gain, it is understood by engineers that engineering foresight and availability of water supply have been a fundamental factor. When many years ago William Mulholland told the people of Los Angeles, as they were considering a bond issue for the Owens River project, "If we

don't build it, we'll never need it!," he stated hard facts.

The Metropolitan Water District of Southern California is an example of the continuation of the Mulholland spirit. In fact, it grew from an action of his. First, in 1924, Mulholland filed for Los Angeles a claim for 1,500 cfs. of Colorado River water. Then, in 1928 the Metropolitan Water District of Southern California was created to bring that water to Los Angeles.

The district is to some extent a counterpart of the "North Jersey District," in that its basis is a voluntary association of municipalities who share the responsibility for the district's debt and likewise share in its water supply.

In 1931, the thirteen cities then in the district voted $220,000,000 to construct the 242-mile Colorado River Aqueduct which was completed in 1941. At midyear 1949, the permanent works built by the district had a book value of more than $204,500,000. Total assets were in excess of $289,750,000.

As of July 1949, sixteen cities and water purveying agencies had joined the Metropolitan, and 26 communities received water service from it. The estimated population served was more than 3,500,000. Total production of water by the district in the fiscal year 1948–49 averaged 588 mgd. or 168 gpcd. Sales of water in the area served by the district are all upon a metered basis.

The first bonds of this district were sold in 1932, a period which will be remembered as unfavorable for sale of securities. Therefore, recognizing the great importance of the project, the RFC purchased its issue of securities. The financial experience of the district throughout has been good and its obligations have been met when and as payment was required.

It will be remembered that the project involves the use of Colorado River water and power derived from Hoover Dam. The Bureau of Reclamation therefore is associated in portions of the project at the Colorado.

The contract for purchase of power from Hoover Dam under the Boulder Canyon Project Adjustment Act imposes on the district the obligation to pay the annual cost of operation and maintenance of the generating equipment installed at the district's request, together with annuities to provide for replacement of such equipment and to amortize its cost within a period of 50 years after its installation, with interest at 3 per cent per annum. The district is also obligated to pay, at rates fixed annually by the Secretary of the Interior, for all of its allotment of firm energy whether used or not. This obligation to pay for unused energy was a heavy financial burden on the district for several years, but contracts made with the city of Los Angeles and four private power companies have eliminated all cost for unused energy reserved for district use since May 31, 1947.

The U.S. Bureau of Reclamation and the district cooperated in the construction of Parker Dam and power plant. All construction work was performed by the bureau and the title to the power plant, dam and reservoir rest in the United States. Funds to cover the entire cost of the dam and reservoir were supplied by the district. Funds for the power plant were advanced by the federal government and approximately one-half the cost is being repaid by the district.

The fact that district operations extended to the Colorado, where work was going on under the terms of the Colorado River Compact and under control of the Bureau of Reclamation, made it necessary for the project to involve federal participation. It should not be overlooked, however, that the district has obligated itself to pay a very substantial portion of the cost of works and equipment at the river.

The aqueduct, purification works and other portions of the project—except part of the works extending service to San Diego—have been funded by the customer cities which have joined in the project. Here again is a major water supply project which rests upon the cooperation and credit standing of its customers, and here again it is obvious that it can be done, if there is a will to do it.

East Bay District

East Bay communities, like most other metropolitan areas in California, have always been acutely conscious of the importance of an adequate water supply as a determining factor in the continued growth and development of the area. At Oakland, the decision to develop a new source of water supply under public ownership had been under consideration as early as 1918, when a serious water shortage presented a grim warning that the existing supply was inadequate to meet the expanding requirements of the rapidly growing area. It seemed apparent that a new source, undoubtedly some distance from the East Bay region, would have to be developed if growth of the area were to continue. It was not until 1921, however, that enabling legislation was passed by the state legislature which permitted the formation of a publicly owned agency which could include both incorporated and unincorporated territory and could extend into more than one county. This act, known as the Municipal Utility District Act of 1921, paved the way for formation of a utility district to embrace the principal cities of the East Bay area located in both Alameda and Contra Costa Counties. An election authorizing the formation of the present East Bay Municipal Utility District was held in May 1923.

The district is the result of the cooperative effort of the people of the region to solve a common problem. An inadequate water supply motivated the voters of nine East Bay cities to join together in 1923 to form a publicly owned agency capable of developing a new source of supply. The utility district was organized as a political subdivision, operating under the laws of the state of California and fully empowered to engage in the development and distribution of municipal water supplies and other public services.

As prescribed by law, the utility district operates without profit. It exists to serve the people of the East Bay area and it is owned and governed by them. The administration of the district is entrusted to an elective body of local citizens. In the East Bay district, the board includes five directors, who represent the people in management of the enterprise.

Financing construction of the system has also been accomplished by the cooperative effort of the people. In 1924 the voters approved a bond issue of $39,000,000 for the construction of the Mokelumne system to bring water from the mountains. Purchase of the distribution system from the privately owned East Bay Water Co. was financed in 1927 by a $26,000,000 bond issue. In

1946, a bond issue for $12,000,000 was authorized to assist in financing the construction of the second Mokelumne Aqueduct. Over the years, through the payment of taxes and water bills, the people of the district have steadily reduced this indebtedness from a total of $77,000,000 to approximately $50,000,000 at the present time. The total value of the district, with proper allowance for depreciation, is now more than $100,000,000.

Today the East Bay utility serves an area of more than 200 square miles and an estimated population of more than 900,000.

New York City System

Any study of the advances made through regional water supply developments should take into consideration the New York City metropolitan area. Population served (7,841,610 in 1950) is substantially greater than that served by the Massachusetts Metropolitan or even the Southern California Metropolitan Districts. Actually, New York City's system is a "metropolitan" one, inasmuch as it is required to provide supplementary water, upon request, to municipalities in the seven counties in which its reservoir and aqueduct system is located.

The Croton and Catskill water storage systems and their transmission aqueducts and distribution reservoirs represent engineering at its best. System additions on the Delaware River were started in 1936, interrupted by World War II and resumed after the war. Dependable yield from the Croton and Catskill systems plus some ground water developments on Long Island is slightly more than one billion gallons per day, yet the years 1946, 1947 and 1948 recorded progressively increasing average distribution of up to 1.2 billion gallons, well above the known safe yields and producing deficiencies which cannot, at the rate or progress on the Delaware system, be alleviated even in part before 1953.

Not until the hot summer of 1949 did the administrative heads of the water system publicly attempt to control the tremendous overdraft upon the supply. It must be said that the "save water" campaign carried on voluntarily by the press, the radio, the school children and other agencies, supplemented by drastic control regulations imposed by the water department, produced a public response unparalleled in peacetime. New Yorkers stopped wasting water to the extent of saving almost 300 mgd. during the first six months of 1950. The reservoirs were almost full by June 1950 and the continued savings by consumers, combined with more than normal rainfall and lower temperatures than in 1949, brought the city to the end of July 1950 with about 10 per cent more water in storage than at the same time in 1949. By early in 1951, all the major storage units were filled.

The major deficiency of the New York City water system is administrative. This deficiency results from two long-term conditions: first, indifferent control of customer demand and waste and, second, separation of the construction, operation and budgeting controls into nonintegrated units. Of the first condition, it may be stated that the refusal to enforce universal metering is contrary to the policy of the better managed water utilities throughout the U.S. Of the second, it is a fact that New York City's water utility is not a unified agency. The Board of Water Supply designs and builds new supply

works. The Department of Water Supply operates and maintains the system, when its construction is completed. Water bills are paid into the city treasury. Appropriation of funds to operate the system is controlled by the Board of Estimate. God sends the rain to fill the reservoirs.

The Department of Water Supply is a career-type civil-service organization, but its employees—including its top officer, the Chief Engineer—are underpaid. The department, as such, does not participate in policy making. The members of the Board of Water Supply and the Department Commissioner, who operate at the policy-making level, are often appointed because of their political standing, not because they are competent engineers or administrators. One must point out, however, that there have been and still are men of vision and competence associated with the Board of Water Supply.

Financial Comparisons

In the U.S. Census "Report on City Government" for 1947, it is shown that the total income of the New York City Water Department was $43,602,000 and that after all debt service and operating expenses were accounted for, the city converted to its general funds $4,816,000. In the early 1930's, water rates were increased by 50 per cent, ostensibly to fund the Delaware supply system in advance. This rate increase produced a surplus of income over expenditures of about $10,000,000 per year for a number of years. Rather than being used to reduce existing debt, this money went into the general city funds.

The debt pattern of the New York system merits study. Reference again to the U.S. census report indicates that the total debt at the end of the 1947 fiscal year was $572,700,000 and the total investment in the water system slightly over $775,000,000. The bonds issued to cover water works construction have a 50-year life, on the theory that the impounding reservoirs, dams and aqueducts will last for 100 to 200 years. Interest on the funded debt in 1947 was $20,677,000.

The payments for interest alone in New York were more than the total that either Chicago or Los Angeles collected for all water service charges. Los Angeles with a plant investment total in midyear 1948 of $210,988,686 had a gross debt at the end of 1947 of only $45,136,000. Putting the facts another way, New York, with a plant investment less than four times that of Los Angeles, had 12½ times the outstanding debt of the Los Angeles system and required ten times the dollars used by Los Angeles for interest payments on debt.

The difference lies fundamentally in the fact that Los Angeles has a unified water department administered by and staffed by personnel of the highest skill. Its affairs are managed in a businesslike manner. New York does not integrate its water system. Its career personnel is underprivileged. Its top appointees are political.

Los Angeles is 100 per cent metered. New York is very little metered. It will continue to dwell in the danger of shortage until it installs meters.

The "authority" plan for water systems is permitted in New York State, through recent legislation. The metropolitan New Yorker reaps the benefit of integrated business management by the Port of New York Authority, an agency of New York and New Jersey that builds and operates docks, harbor facilities, tunnels and bridges. High-

est level consideration of the values to be derived from establishment of a New York water and sewer authority is clearly indicated.

Business-like management of the entire water system from source to faucet is the long-range answer to New York City's water emergencies, and the first line of effective control lies in universal metering.

Advantages of Regionalization

Since municipal water supplies are established in communities which are political subdivisions of the states, the state local water utility relationships are basic and important.

Elsewhere it has been noted that Wisconsin has established, through its public service commission, particularly effective control of municipal water utility management. This pattern of state guidance is of great value to the water consumers and merits extension into the other states and duplication, *in principle,* to the fullest extent possible.

The "home rule" shibboleth is perhaps the nation's greatest contribution to inefficiency, particularly in the field of utility management. In many areas the city or town boundaries no longer define the limits of water supply service. In the majority of water works systems, in population groups of 2,500 or less, the routines required from day to day in operation are insufficient to make possible the provision of the greater skills which public safety requires. Likewise, since the number of employees in water works the country over averages one per 1,000 persons served, it becomes clear that the very small water utility, operated as a unit of itself, cannot be expected to conform to the best patterns of management.

In the interest of better control of water supply for the public benefit and in view of the successes already achieved by water districts and authorities, it appears constructive to consider county water systems or district water systems territorially adjusted to a community of occupational interests. That such systems would not need to be 100 per cent physically interconnected is evidenced by the Washington Suburban Sanitary District. That municipal boundaries are unimportant in water supply operations is evidenced by the Hackensack Water Co., which provides water service in 53 separately incorporated communities in northern New Jersey. It is obvious to anyone who is familiar with this territory that 53 separate water supplies and systems would not serve the public interest.

Further exploration of the values of county or district water systems makes it clear that better equipment for water main extension and maintenance work could be provided as the mileage of installed mains increased. Meter reading and repairs could be handled by men who were specialists at the jobs. Billing could be done with better equipment and more efficiently with a larger group of accounts to handle. The man or men assigned to maintain pumps and other equipment could be better trained and more efficient. The negative result would be that there would be fewer jobs for untrained men.

Consistent with the opinion that grouped operation and management of small water systems is in the public interest, one can advocate stronger supervisory powers for public service commissions, state boards of health, state boards of accounts and other state agencies, all to the end that better water service be provided.

One agency now in every state has supervisory powers over water supply in its safety aspects—that is the state

board of health. Through the activities of the state sanitary engineer and his staff, incalculable benefit has been brought to water users in every state where this agency has been put into action. Through their approval powers for all new projects, the state engineers have lifted the standard of small town water works construction. The field men in their contacts even with the smallest water works bring information and advice far beyond the category of water quality, acting as counselors on many items of routine operation and repair practice. The activities of this agency in the various states are accepted by the management of water systems. It is a state-by-state activity of greatest value. It should be strengthened.

Good Management

It has been indicated how great cities and regions have profited by the handling of the water supply problems upon the basis of competent engineering and good management. It is already well known that the individual cities in Wisconsin have been served by competent water boards and career employees controlled by the Public Service Commission. The good judgment of many towns and cities in other states has preserved for them the fruits of efficient management even though the laws in the state may not afford the real encouragement to good management that the people deserve. It has been shown that authorities, districts and regional systems can be financially solvent and successful.

Water works are "business." They should be so regarded by the people and the public officials where the property is publicly owned. There is no town in which people are engaged in the normal ways of American life, where the water supply system cannot be successfully and profitably operated, if the people will it.

Selection of Well Pumps

By G. E. Hubbell

A paper presented on Oct. 26, 1950, at the Michigan Section Meeting, Detroit, Mich., by G. E. Hubbell, Civ. Engr., Hubbell, Roth & Clark, Inc., Detroit, Mich.

MUCH has been written about the proper selection of deep-well pumping equipment, and it would seem that little can be added to the literature covering this subject. Many reliable pump manufacturers have excellent pumping equipment to offer, all of which meet field requirements.

The municipal engineer must rely to a great extent on the ability of the pump manufacturer to provide pumping equipment properly designed and fabricated. It is his responsibility, however, to provide the manufacturer with accurate data, adequately describing the conditions of installation and any special requirements, so that the manufacturer can offer suitable equipment. This requires a determination of the capacity required, the diameter and yield of the well, the type of pumping equipment needed, and the materials of construction.

Required Yield

The amount of water required can generally be determined from population data, fire requirements, storage facilities and, in existing systems, known deficiencies. Prior knowledge of a given well field or field testing of the general water supply area will indicate the availability of an adequate ground water supply by which the number and diameter of wells can be fixed.

Where small yields of less than 100 gpm. are required, the tendency is to think in terms of 4- to 6-in. wells. The use of wells of these diameters should be discouraged, however, as the construction of wells of adequate diameter will more than repay the initial additional construction cost in longer service life and in permitting a better selection of pumping equipment. A minimum diameter of 12 in. is desirable for all municipal wells.

An adequate field test of the well must be made to permit the proper selection of suitable pumping equipment. The test comprises:

1. Measurement of the inside diameter of the well.
2. Measurement of the depth of the well from the top of the casing to that of the screen, and to the bottom shoe.
3. Determination of the vertical alignment of the well.
4. Continuous field pumping for not less than seven days at a uniform rate equal to the expected or desired capacity of the well.
5. Careful measurement of the water level in the well both before and during the test, and, if possible, the determination of water levels in affected observation wells.
6. Observation of the rate of recovery in the well and observation of the well after the pumps have been shut down.

In addition, the relationship of the static level at the time of testing to long term ground water levels must be determined to provide pump settings suitable for lowered water levels, and also to determine the variation in the total pumping head. In order to correlate the test information with existing information, water level observations must be based on U.S. Geological Survey procedures.

It may appear that test information can be obtained relatively easily. Actually, conducting an adequate test is a major operation.

Because many wells are drilled in locations where power is not available, pump tests must often be conducted with gasoline-engine–driven pumps. Such pumps are variable in their speed and require constant attention to insure uniform pumping rates. Well drillers, in general, are not fully aware of the need for seven-day tests. As testing equipment is usually furnished and operated by the drillers, adequate inspection or supervision must be provided to assure accurate test results. The author's attention was recently directed to a well installation in which, on the basis of an 8-hour pump test, a considerable sum of money was spent on the construction of a well house and the installation of pumping equipment, only to have the wells pumped dry after 18 hours of continuous operation.

The drawdown record (Fig. 1) of pump tests conducted at a continuous rate of 500 gpm. on a 12-in. well drilled at Clawson, Mich. in 1944 indicates the necessity of long-period pumping to determine well performance adequately.

Water level measurements within a well can be made either with an air gage and drop pipe, a chalked tape or an electric sounding device. With water levels which are less than 100 ft. below the casing top, the chalked tape method is considered the simplest and most positive means of determination.

The safe yield of a well can also be determined by field tests, to avoid the selection of oversized pumping equipment.

Types of Pumps

Pump manufacturers offer a number of different kinds of pumping equipment, and the engineer is faced with the problem of selecting the proper type for a given installation. Well pump types suitable for municipal use include: [1] reciprocating pumps; [2] jet pumps; [3] airlift pumps; and [4] vertical centrifugal pumps.

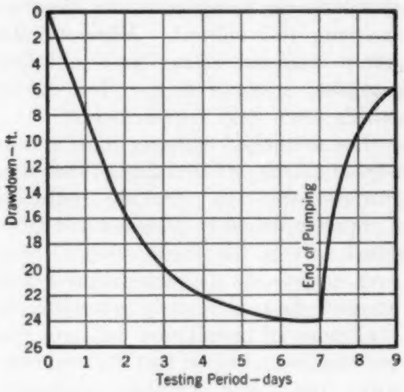

Fig. 1. Drawdown in Seven-Day Pumping Test

The drawdown of a 12-in. well in Clawson, Mich., at a continuous pumping rate of 500 gpm. is indicated in the above diagram.

Reciprocating pumps are not generally used today. They are limited in capacity, comparatively expensive and bulky, and their stuffing boxes, leather gaskets and other parts require considerable maintenance.

Jet pumps are a rather new development in the pump field. Like recipro-

cating pumps, they are limited in capacity with an average range of 5 to 70 gpm. Their maximum lift is 150 ft. The advantages of this type of pump are its ruggedness, dependability and easy maintenance. The author has had one domestic unit in operation for the past four years, during which the unit has required no oiling or maintenance of any kind. The development of plastic flexible pipe has made the installation of jet pumps simple, rapid and ideally suited for installation in crooked wells. If a supply must be developed from a 4-in. well within the head range mentioned, the jet is an ideal selection.

Although air-lift pumps offer a simple and sturdy means of pumping water, they are not now widely used either in old or new installations. Their disadvantages include an efficiency of less than 50 per cent and the necessity to repump for high service and deep wells to provide proper submergence. These drawbacks outweigh their chief advantage of having no moving parts below ground.

The vertical centrifugal pump is almost universally used for the pumping of municipal wells. High overall efficiencies of at least 70 per cent, direct pumping to high service, and general all-around seviceability account for the wide popularity of this type of pump.

To select a deep-well turbine pump properly, it is necessary to plot a combined head-capacity curve showing the yield of the well for low, average and high initial static-water levels and superimpose on this graph the characteristics of the various pumps under consideration. The method has been well described by Alexander (1). Graphic representation of head capacity conditions is a real aid in selecting the proper pump. The relation between capacity and head in the Clawson well is shown in Fig. 2.

Vertical centrifugal pumps are made in many sizes and stages to operate at 870, 1,170, 1,750, or 3,400 rpm. The pump manufacturers are generally relied upon to provide the proper diameter and number of bowls to fit a specified speed. The general method followed in making this selection has been well explained by A. O. Fabrin (2).

Centrifugal pumps can be classified according to their "specific speeds," or

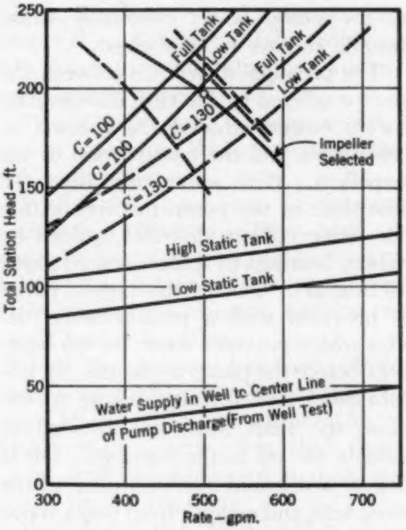

Fig. 2. Head Capacity Curve

The combined head capacity curve of the Clawson, Mich., well shows the yield for low, average and high initial static water

N_S. Specific speed is the relation between the discharge in gallons per minute, the head per stage in feet, and the speed of the pump in revolutions per minute:

$$N_S = \frac{\text{rpm.}}{\sqrt{H}} \times \sqrt{\frac{\text{gpm.}}{\sqrt{H}}}$$

The N_S of deep well centrifugal pumps ranges from 1,500 to 4,100, with optimum value at 3,500. An empirical re-

lationship between the impeller diameter, the throat diameter and the specific speed has also been formulated so that the optimum impeller diameter and the number of stages for a given discharge and head condition can be calculated. If freedom from difficulties is desired, the pumps selected must have a capacity less than the sustained yield of the well. Similarly, the pump bowls must be set below the lowest anticipated water level in the well. Negative heads at the pump bowls eventually cause trouble and are to be avoided.

The principal difference between the pumps offered by the various manufacturers centers around the method of lubrication and the construction of the impellers. With water lubrication, the line shaft of the pump revolves within the rising column of water, guided by rubber bearings in spiders spaced about 10 ft. apart. Usually this type of pump is provided with a prelubrication device which provides water on the bearings before the pump is started. In oil-lubricated line shafting, tubing to enclose the shaft must be provided to confine the oil to the bearings. Oil is fed by a solenoid-operated oiler to the shaft tube and escapes from ports above the top bowl.

Regardless of the type of shaft lubrication, all manufacturers provide water lubrication of the rubber or bronze bearings within the pump bowls. The choice of lubrication appears to be a matter of individual preference as both methods give satisfactory performance. Impellers can be obtained fully enclosed or semi-open. The principal claims for the open impeller are freedom from difficulty caused by sand and ready adjustment from the top of the line shaft, permitting about 25 per cent variation of the pump capacity. Closed impellers generally afford higher sustained efficiencies and somewhat lower thrust loads. Although the majority of deep-well turbine installations use closed impellers, either type will give good service.

Because electric motor drives for deep-well centrifugal pumps must be built to fit the pump discharge head, all pump manufacturers have developed standard motor-drive designs. These have been thoroughly tested and have proved adequate; it is necessary only to specify that the motor and pump head be built to form an integral unit and that the motor be a vertical, hollow-shaft, splash-proof, squirrel-cage induction motor of specified voltage and speed, with adequate thrust bearings and with horsepower capacity to drive the pump continuously without inducing a temperature rise of over 40°C.

A typical set of specifications, used in the purchase of a deep-well turbine pump for the village of Lowell, Mich., appears in the Appendix to this paper. In several recent well installations, a compact and inexpensive type of pump head enclosure was used to eliminate the customary well pumphouse. The enclosure consists of a metal-insulated box approximately 5×3 ft. and $4\frac{1}{2}$ ft. high, with one side hinged to permit access to the pump. The housing is heated with an electric strip heater.

Materials

Deep-well turbine pumps can be obtained in a variety of materials; it is necessary, therefore, to select and specify the material for each pump part. Low initial costs frequently determine the selection of materials, but this practice usually results in early pump replacement.

Although genuine wrought-iron pipe may sometimes be specified, column pipe is generally made of standard

black steel pipe. Where extremely active waters are encountered, lined and coated pipe may be used. Line shafting is generally constructed of cold-finished, turned, ground and polished precision steel shaft; where corrosive conditions exist, stainless steel is used. Shaft-enclosing tubing is made of extra strength steel pipe, with bronze shaft bearings. Pump bowls are generally made of close-grained high-quality cast iron, free from all faults. For service under corrosive conditions, all-bronze bowls should be specified. Pump shafts should be made of stainless steel of not less than 12 per cent chromium content. Impellers should be of bronze to give optimum protection against corrosion and wear. Cast iron, either plain or enameled, is also specified but is not as serviceable as bronze.

The specifications of certain typical installations are listed below:

The installation at Willow Run, Ypsilanti, Mich., comprises three 24-in. wells 81 to 87 ft. deep. Each well is equipped with a 3,500-gpm., 46-ft. head, single-stage, 1,170-rpm. turbine ($N_S = 3{,}980$); a 14-in. column; 3-in. shaft tube; $1\frac{11}{16}$-in. shaft and an oil-lubricated enclosed enameled cast-iron impeller.

The Lowell, Mich., installation consists of a 17-in. id. Kelly well, 39 ft. deep with a 250-gpm., 180-ft., 8-stage, 8-in., 1,760-rpm. turbine ($N_S = 3{,}550$); a 5-in. column; a water-lubricated $1\frac{1}{2}$-in. shaft and an enclosed bronze impeller.

Clawson, Mich., maintains a 12-in. well, 168.5 ft. deep, equipped with a 500-gpm., 195-ft., 6-stage, 10-in., 1,760-rpm. turbine ($N_S = 2{,}850$); an 8-in. column; $2\frac{1}{2}$-in. shaft tube; $1\frac{1}{2}$-in. oil-lubricated shaft and an enclosed bronze impeller.

Oakland Hills Country Club, Birmingham, Mich., maintains a 12-in. well, 150 ft. deep, with a 200-gpm., 100-ft., 12-stage, 6-in., 1,760-rpm. turbine ($N_S = 5{,}000$); a 5-in. column; $\frac{3}{4}$-in. water-lubricated shaft and a semi-open bronze impeller.

The Willow Run housing installation at Ypsilanti, Mich., maintains the following wells:

Well No. 2 is a 12-in., 126-ft. deep well with a 600-gpm., 180-ft.-head, 8-stage, 10-in., 1,760-rpm. turbine ($N_S = 4{,}210$); 8-in. column; $2\frac{1}{2}$-in. shaft tube; $1\frac{1}{2}$-in. shaft, oil-lubricated, and an enclosed bronze impeller.

Well No. 3 is a 12-in. well, 99 ft. deep, with a 420-gpm., 201-ft.-head, 6-stage, 10-in., 1,760-rpm. turbine ($N_S = 2{,}630$); 6-in. column; 2-in. shaft tube; $1\frac{1}{4}$-in. shaft, oil-lubricated, and an enclosed bronze impeller.

Well No. 5 is a 24-in., 115-ft. deep well, with a 420-gpm., 115-ft.-head, 4-stage, 10-in., 1,760-rpm. turbine ($N_S = 2{,}540$); 6-in. column; 2-in. shaft tube; $1\frac{1}{4}$-in. shaft, oil-lubricated, and an enclosed bronze impeller.

APPENDIX

Specifications for Deep Well Turbine Pump and Motor, Lowell, Mich.

1. *Description.* Deep well turbine for installation in an existing 26.5-in. id. Kelly well, Lowell, Mich.

2. *Capacity.* The pump shall have a capacity of 200 gpm. at 180 ft. total station lift, and not over 230 gpm. at 165 ft. of total station lift. Total station lift is calculated as the vertical distance from the pumping level in the well to the center line of pump discharge plus the discharge head at that point.

3. *Motor.* The motor shall be a vertical, hollow-shaft, totally enclosed, fan-cooled, ball-bearing, oil-lubricated type

directly connected to the pump shaft. It shall employ a 440/220-v., 3-phase, 60-cycle power for a squirrel-cage induction type 40° C. motor, with a speed not exceeding 1,800 rpm. An adequate oil-lubricated thrust bearing shall be provided. A suitable base of high grade cast iron shall also be provided for mounting the motor.

4. *Line Shaft.* Enclosed, turned, ground and polished precision shafting of ample size in 10 ft. interchangeable lengths shall be provided. Line shaft bearings shall be of rubber, and of the water-lubricated type. Bearings held in bronze retainer rings shall be spaced not more than 10 ft. apart, center to center.

5. *Column Piping.* Screwed couplings of steel shall be furnished in interchangeable sections not more than 10 ft. long. Standard weight id. pipe shall be employed.

6. *Pump Bowl Assembly.* The pump bowls shall be of close-grained cast iron, free from blowholes, sand holes and all other faults, and shall be accurately machined and fitted to close dimensions.

The impeller shall be bronze and shall be of the enclosed type, accurately machined and finished, and perfectly balanced both mechanically and hydraulically. A nut shall be provided at the motor head to permit adjustment of the impeller.

The impeller shaft shall be properly supported on each side of the impeller by adequate water-lubricated bearings. The tail bearing shall be bronze and shall be grease packed.

7. *Suction Pipe and Strainer.* Suction pipe shall be furnished. A brass strainer having a net inlet opening area of not less than four times the area of the suction pipe shall be included.

8. *Water Level Indicator.* A suitable altitude gage and air line of copper tubing sufficiently long to indicate the water level in the well shall be furnished together with a hand-operated air pump.

9. *Descriptive Matter.* The bidder shall submit with his proposal complete dimensional prints and descriptive matter, including performance characteristics, to provide a complete description of the equipment offered.

10. *Pump and Well Data.* The following shall apply:

Base of motor—elevation 123.0
Discharge—standard
Top of well—elevation 123.0
Water surface in well at 200-gpm. pumping rate—elevation 89.0
Bottom of well—elevation 74.5
Size of well, id.—26.5 in.
Distance from base of motor to bottom of bowls—45 ft.
Suction pipe size—5 in.
Suction pipe and strainer length—2 ft.
Line shaft diameter—1 in.
Column piping; standard weight, id.—5 in.
Design pumping rate—200 gpm.
Total station lift at design pumping rate—180 ft.
Size of pump bowls, od.—7½ in.
Number of stages—7
Speed of pump—1,800 rpm.
Motor size—15 hp.
Electrical power—220/440 v. 3-phase 60-cycle

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Dynamiting as a Means of Increasing Well Yield

By Harold House

A paper presented on Oct. 26, 1950, at the Michigan Section Meeting, Detroit, Mich., by Harold House, Board of Water and Light Commissioners, Lansing, Mich.

WATER for the city of Lansing, Mich., is obtained from 87 deep wells, 42 of which are pumped by air-lift pumps, and 45 by deep well turbo-pumps. These wells are located in a zone or belt which, roughly, runs from northwest to southeast in the city. The well diameters vary from 6 to 14 in. and the average depth is 425 ft. They are cased through the glacial drift into rock which is found approximately 70 ft. below the surface.

One of the major problems facing the water supply field is that of maintaining well yields as close to their original level as possible. Decreases in yield are attributed to decreases in static levels and to the shutting off of water entering the well. The latter condition may be caused by the plugging of the interstices in the well wall by suspended matter in the water. Plugging may also be caused when the sudden release of pressure, which occurs as water enters the well, releases the dissolved carbon dioxide. In the resulting reaction, the calcium bicarbonate decomposes, forming insoluble calcium carbonate and more free carbon dioxide, thus building up a coating on the walls of the well which gradually seals it off to the entry of water.

In 1944, after unsuccessfully trying various methods, such as acid and dry ice treatment and reaming of the walls of the wells, the Board of Water & Electric Light Comrs. entered upon a schedule of dynamiting to maintain production capacity. The results indicate that dynamiting is the answer to this problem for the sandstone formations prevailing in the Lansing area. To date, 40 wells have been dynamited twice. The production increase attributable to dynamiting totals 11.8 mgd., representing an increase of 132 per cent in specific capacity. The average lift before and after dynamiting was 182 ft. and 165 ft., respectively. So far, dynamiting has been limited to wells pumped by turbo-pumps.

Dynamiting Procedures

Before transporting dynamite and caps to a well it is necessary to advise both the Police and Fire Departments of the route to be followed and the location of the well to be dynamited. Dynamite and caps must be transported separately and cannot be left at the site overnight.

Before dynamiting, a study must be made of the well log which shows the various formations encountered in drilling the well. Dynamiting is limited to the strata showing water-bearing material; 10-lb. shots of 50 per cent nitroglycerine dynamite are detonated at 5-ft. intervals. The charges are wrapped in cheesecloth and lowered into the

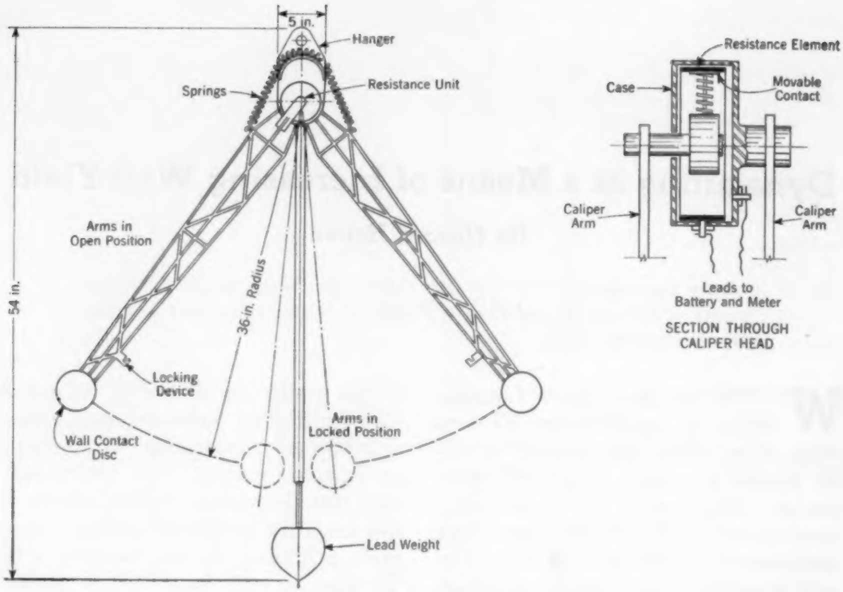


Fig. 1. Well Caliper

The well caliper consists of two spreading arms which actuate the contact point on a rheostat. The varying voltage drop gives diameter readings, the maximum measurable diameters being 72 in.

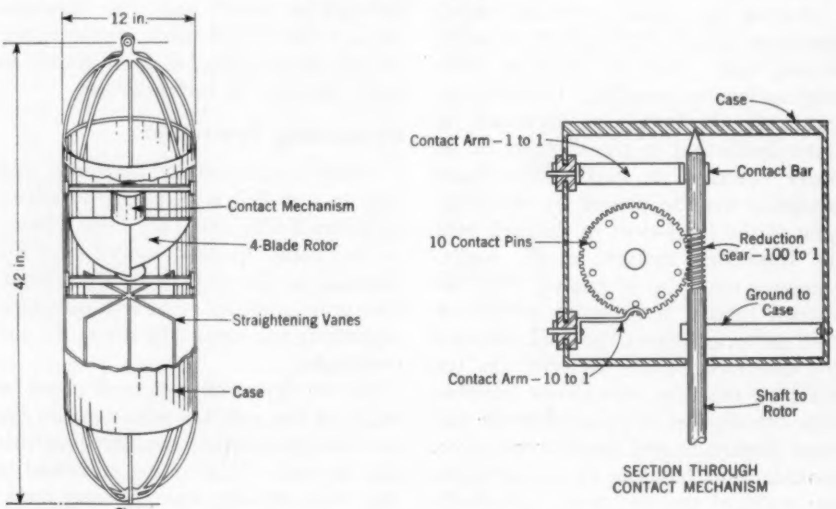


Fig. 2. Flow Meter

The vertical current meter is an adaptation of a stream flow meter built for vertical use and calibrated to read the velocity from revolutions of the impeller.

well by means of the electrical detonating wire which is calibrated for length. When the charge reaches a predetermined level it is detonated, the wire is withdrawn, another 10-lb. charge is attached. The same procedure is then repeated. No charge is detonated closer than 50 ft. from the bottom of the well casing.

One well was dynamited with 100-lb. charges set at 50-ft. intervals along the water-bearing strata, but tests indicated that better results are achieved by the 10-lb. shots. In addition, neighborhood complaints of concussion are lessened when the smaller charges are used.

After dynamiting, the well is cleaned to its original depth by bailing, using a well rig; it is then ready for the installation of a test pump.

To extend the knowledge of the water table and of the amount and location of the water influx into the wells, two instruments were built and used on the wells as they became accessible through pump cleaning, dynamiting or new drilling. The first (Fig. 1) consisted of a spreading arm caliper, the arms of which actuated the contact point on a rheostat, the varying voltage drop giving readings calibrated as diameter measurements. The input voltage is of course held constant. The maximum measurable diameter is 72 in.

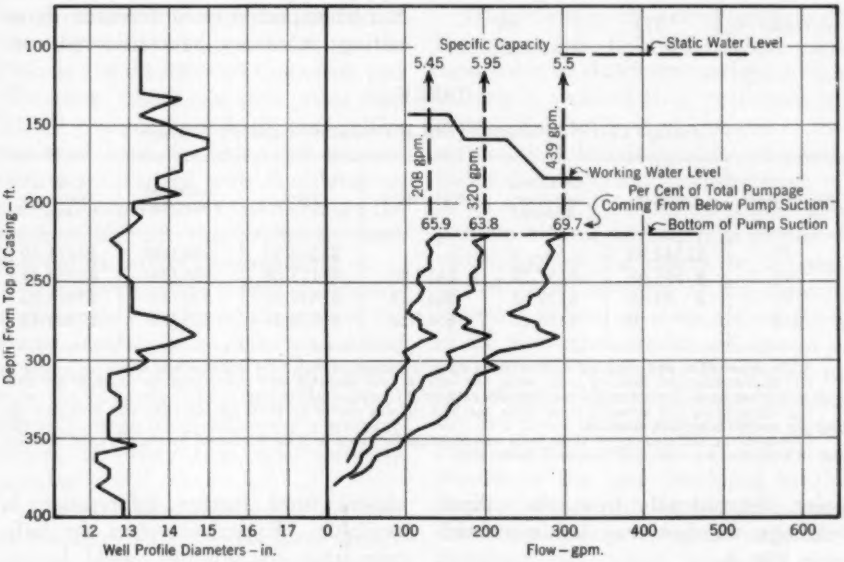


Fig. 3. Study of Well NW-8

With a knowledge—furnished by caliper readings—of the diameter of the well at any given point, the flow may be determined.

The second instrument (Fig. 2) is an adaptation of a stream flow meter built for vertical use and calibrated to read velocity in feet per second as a function of the speed of revolution of the impeller. With a knowledge of the diameter of the well at any given

TABLE 1

Specific Capacity of Wells Before and After Dynamiting

Well	First Dynamiting		Second Dynamiting	
	Before	After	Before	After
PM-6	1.5	3.1	1.8	2.9
C-12	3.2	7.5	2.1	3.8
C-13	2.5	8.8	3.7	7.4
Avg.	2.4	6.5	2.5	4.7
Increase—%	171		88	

each increase in the flowmeter setting, the flow in the well is calculated and the results plotted on a curve (Fig. 3).

As noted above, three of the 40 wells dynamited were dynamited a second time. The average increase in specific capacity (gallons per minute per foot of drawdown) before and after dynamiting was 171 per cent the first time and 88 per cent the second time, as shown in Table 1.

This may be an indication of what can be expected from repeated dynamiting; it cannot be considered conclusive until further information is available. Experience thus far indicates that dynamiting should be repeated at 4- to 5-year intervals.

TABLE 2

Average Cost of Dynamiting and of Productive Capacity Increase

No. of Wells	Contract	Dynamite and Misc. Material	City Labor	Total	Increased Yield—gpd.	Cost of Water per mgd.
2*	$1342.93	—	—	$1342.93	398,000	$3374.20
9†	$ 548.68	$157.26	$411.92	$1117.86	496,000	$2253.75
8‡	$ 59.38	$129.83	$648.11	$ 837.32	320,000	$2616.62
21§	0	$163.15	$563.13	$ 726.28	276,000	$2631.44

* The dynamiting and cleaning of these wells was contracted for on a time and material basis.
† In dynamiting and cleaning these wells, the well rig and operator were contracted for at $4.00 per hour with additional labor, dynamite and miscellaneous material furnished by the city.
‡ In dynamiting and cleaning these wells, the well rig was rented at $5.00 per day; the city furnished the operator and all labor and material.
§ Dynamiting and cleaning of these wells was accomplished by a well rig purchased by the city; the operator and all labor and material were furnished by the city.

point, determinable from the caliper readings, the flow may be determined as in Fig. 3.

When preparing a well for dynamiting, the pump must be removed and the cross section of the well determined by calipering. After dynamiting and cleaning, the well is again calipered, the well flowmeter is lowered into the well with a calibrated cable, and the test pump is installed. Flowmeter readings are taken while the pump is in operation at 5-ft. intervals from the bottom of the well to the bottom of the pump suction and repeated for various discharge settings of the pump. At

Cost of Dynamiting

A tabulated breakdown of the average cost of dynamiting and cleaning, and the average cost per million gallons a day of the increase in productive capacity appears in Table 2. The estimated cost, per million gallons produced daily, for a new well extension, including necessary transmission mains, well houses, meters, and other equipment, amounts to $98,000.

The Directional Charge Method of Shooting Wells

By George L. Smith

A resume of a paper presented on Sept. 20, 1950, at the Wisconsin Section Meeting, Oshkosh, Wis., by George L. Smith, Sales Mgr., G. L. Smith & Co., Milwaukee, Wis.

THE directional charge method of shooting oil wells was originally developed about eight years ago by the Byron-Jackson Co. of Los Angeles. Early experiments with this method of shooting wells first got under way in 1945 in the oil fields of California and Wyoming. Since that time, more than 60,000 charges have been fired. The sustained need for increased production of oil coupled with the ability to shoot zones selectively has increased the applicability of the technique and spurred its further development.

The driving force behind this development was a desire on the part of the Byron-Jackson Co. to develop a method of shooting oil wells which would eliminate the hazards inherent in the use of nitroglycerine, thus allowing a greater degree of safety than was formerly possible.

A powder developed by E. I. du Pont de Nemours & Co. for use in the army's bazooka shell provided the foundation upon which this method of shooting wells was based. Although the design of the charge was created from well known principles, these had not been put to practical use until about 1888, when an American chemist, Dr. Charles Monroe, experimenting with a primitive hollow charge, blew a hole in the top of a steel safe. E. I. du Pont de Nemours & Co. first adapted the charge for use in light caliber rifles. This type of charge permits the force exerted by the powder to act along a straight line, thus concentrating all of its power in one direction.

Well Charge

When used in oil well or water well shooting, the individual shots are mounted in an aluminum carriage, which in turn is attached to a steel cable by means of a heavy steel connecter; the entire unit is then dropped into the well. Inside the cable, but insulated from it, is an electrical conductor cable—the positive side of an electrical circuit—which enables the charge to be controlled by an operator at the surface. Fourteen individual shots are mounted in the aluminum carrier and spaced 6 in. apart at successive 90° angles to each other, so that the distance between any two charges on a single side is 24 in. Each charge contains 7½ ounces of powder of the type developed by du Pont. Contact with the powder is provided by a detonator, located under the aluminum cap, which forms the rear cap of the charge itself.

The overall length of the plastic case is 5 in.; the outer diameter of the charge is 2½ in. The cone shape of the powder at the end of the charge is so designed that the metal shield which holds the powder in place provides an air space in the nose of the charge. When the charge is detonated, the copper cone is inverted and the powder expands through the areas of least resistance, traveling out through the nose of the charge itself. When the nose of the shell is placed near the face of a well

and the charge is detonated, the force of the concussion, traveling at a rate of 30,000 fps., will bore a hole 2 in. in diameter and more than 20 in. deep back into the formation. The secondary fractures that occur beyond this fissure extend from 6 to 8 ft. The direction of these crevices, extending away from the source of the force, gives the appearance of a crow's foot. The effect of discharging fourteen of these shots at once can be compared to picking up the sandstone of the well and shaking it loose, thus distributing the sediment of fine silt that has been formed at the well face.

Sand

In the five projects that have been completed to date, very little sand has caved back into the well hole. As a result, very little bailing has been necessary. Bridges which formed at the location of the charge in each of the wells were readily broken up in ten to fifteen minutes by running in a string of spudding tools; the sand was allowed to drop to the bottom of the hole.

The largest quantity of sand produced in any one project was 100 cu.ft. This fill-in was deposited at the bottom of the well after 20 charges of 14 shots each had been used. The average distance between each charge was approximately 40 ft.; the charges were set off at depths of from 880 to 1,775 ft.

Three of the five water wells which have been shot in this manner, with excellent results, are located in sandstone areas known locally as the St. Peter, Eau Claire and Mt. Simon Sands. Well No. 1 showed an increase of 600 per cent in specific capacity per ft. of drawdown; well No. 2, 375 per cent; well No. 3, 221 per cent; well No. 4, 100 per cent; and well No. 5, 1,100 per cent. Well No. 4 was shot in a combination of sandstone, lime rock and shale so interspersed that a clear formation in which to perform the shooting was difficult to obtain. As a result, one charge was placed in the lime rock area, two charges were placed in the sandstone below the shale, and another charge was placed in a sandstone area between two layers of shale.

Drawdown

It was determined conclusively that the drawdown in well No. 5, a lime rock well, was caused, not by the recession of water tables, but by the filling up of crevices in the rock with silt. The pump was operated on an intermittent cycle and each time it stopped silt was deposited near the face of the well. A barrier had gradually been built up which retarded the flow of water into the hole. After 14 years, this well had lost almost its entire capacity; its rate of yield had dropped to $\frac{3}{8}$ gpm. per ft. of drawdown. Seven charges of 14 shots each were set off in an area of 125 to 300 ft., covering the entire lime rock open hole. The well was then pumped for two weeks, and the yield was increased to more than $4\frac{1}{2}$ gpm. per ft. of drawdown. This well now has a static water level and capacity yield comparable to that which existed at the time it was first drilled in 1935.

This experience points the way to a different conception of what has been causing drawdown in the water wells of this area during the past fifteen years. Although the author does not deny that water tables are dropping seriously, he believes—and this method of shooting appears to be demonstrating—that a great deal of drawdown is not caused by receding water tables alone, but also by the filling up of crevices and other water passages with silt which retards the flow of water to the face of the well. When this barrier is removed, a greater inrush of water can occur.

Distribution System Problems

By H. F. Wiedeman

A paper presented on Oct. 13, 1950, at the Alabama-Mississippi Section Meeting, Mobile, Ala., by H. F. Wiedeman, Wiedeman & Singleton, Engineers, Atlanta, Ga.

DURING the period from 1920 to 1940, the growth of cities in the South was gradual, and plans for the distribution of water or for the extension and improvement of existing water systems could be based upon reasonably long-term projections of population and water use, with some degree of assurance that these plans would fulfill water requirements for the estimated period.

During World War II, however, and especially since its close, the unprecedented growth of population and industry and the consequent greatly increased demand for water have upset all earlier calculations of long-range water needs. Low pressure and inadequate service have become common in many southern cities; in certain areas, particularly within the larger cities, there is a complete loss of pressure and stoppage of service during peak-load periods.

Although it was generally thought that the demand for water would decrease when the war ended, whatever decreases did occur proved to be of short duration. Water use is considerably greater now than it was during the war, and the upward trend is continuing.

Much of the growth has been occurring outside city limits or in areas recently annexed to cities. As many of these areas lie at elevations above the hydraulic plane of the existing water systems, they have required expensive booster-pump and tank installations. Some cities have refused to construct water lines outside their corporate limits, but, generally, the needs of outlying sections have been met by the assessment of abutting property, the imposition of tapping charges, construction by the county or by developers—either with or without reimbursement—or other methods. The annexation of additional areas has frequently brought more prestige than profit to rapidly expanding cities because the cost of providing services to these areas has often been greater than the additional revenue obtained.

The continuing increase in water use has forced the construction of additional facilities in practically all elements of the South's water systems and has created serious difficulties in the arterial mains of distribution systems. The principal distribution deficiencies may be listed as:

1. Inadequate feeder mains.
2. Lack of overhead storage-tank capacity to provide for peak hourly rates, or improper location or elevation of such storage.
3. Low coefficients of friction due to tuberculation of mains.

Data derived from a number of systems in the Southeast indicate that the maximum rate of use is approximately 40 to 50 per cent greater than the average daily rate unless industrial use constitutes the major portion of the demand. It is these peak rates which are

generally responsible for operating difficulties in the distribution systems.

Feeder Mains

For adequate service to be provided, especially in the larger cities, the location and size of primary feeder mains must be determined on the basis of a thorough study of pressures and flows in the system. Pressures may best be studied by portable recording pressure gages placed at a number of points on the system, the ground elevations of which are known. The readings on the gages need not be simultaneous as they may be referred to the total rate of use at any given time if clocks are synchronized. Flows in primary feeder mains may be determined by pitometer readings. When these are reduced to percentages of the total rate of use, they may be used to calculate flows in various parts of the system. Hence, losses at various rates of flow may be determined and the effect of various sizes or locations of reinforcement mains determined.

Where business machines are used in the water utilities' accounting systems, the total monthly readings in each meter zone provide an excellent check on rates of use in each area.

Industrial Use

Although industrial use is frequently a major cause of operating difficulties it does not receive the attention it should from water works management. Too often, contracts for service are made on the basis of maximum daily or monthly use without regard for the storage which must be provided to reduce peak demands to a reasonable quantity.

A clear example of difficulties caused by industrial use is presented by the experience of one city in Georgia which was suffering from unusual pressure drops in one section. The source of the difficulty was traced to a textile mill using 600,000 gpd. This consumption amounts to an average of 416 gpm., but peak rates of 1,280 gpm. were measured, often during the hours of peak demands upon the system.

One of the best industrial-municipal contracts for water use which has come to the attention of the author is that between a bleachery using 2 mgd. of water and a South Carolina water plant. The arrangement may best be described as an "off-peak" contract by which the commissioners of public works have agreed to furnish water at off-peak hours, through a separate line, to a 5-mil.gal. reservoir constructed by the bleachery. The arrangement makes possible a materially reduced rate to the bleachery and the profitable use of water works capacity during periods of low demand. Had the demands of the bleachery been superimposed upon the daily peak load of the system, the construction of additional facilities would surely have been hastened.

Elevated Storage

The principal functions of elevated storage are [1] to provide water during periods of peak demand upon the system and [2] to furnish a reserve for fire protection or other emergencies.

The rate of flow from the source of supply, combined with the increase or decrease in existing elevated storage, plotted for a 24-hour period, will generally show that the amount of water required during peak hours of the day, at rates in excess of the average rate, constitutes 15 to 20 per cent of the daily total use. This ratio seems to remain reasonably constant for most systems even as total use increases. If the records of consumption are available, and the amount of water to be re-

tained for emergency use is also established, the amount of storage required to decrease the peak rate to any desired point may be readily determined.

The most effective location of elevated storage—a factor that generally determines its effectiveness in maintaining pressures and flows in the system—is either on the side of the distribution system opposite the source of supply, or else at or near the center of distribution. In either location, the storage must be connected to a feeder main of adequate size for maximum effect.

Examination of a system in Georgia recently revealed that a 300,000-gal. tank remained full without serving the system, because the pressure on the distribution side of the altitude valve was greater at all times than that required to fill the tank. Further investigation showed that when the tank was first constructed, its height was determined by the main pressures in the immediate vicinity. After a few years, however, water use in the area had increased to a point where the tank would not fill and was generally dry before the end of the daily peak. A secondary feeder was then constructed which increased pressures so much that the tank was inoperative. Proper thought in the beginning would probably have resulted in the construction of a secondary feeder and the deferment of tank construction.

To function properly and make the best return on its investment, a storage tank should be filled during off-peak hours and drawn upon during peak hours, thus reducing the draft on the source of supply and the feeder mains. To function in this manner, the storage must have the proper elevation and must be connected to the system by mains of adequate size.

If more than one tank is to be installed in a system the relative elevations of the various tanks must be considered. Pressure studies may indicate differences in the water level at the proposed locations which are caused by the capacity of the feeders or the rates of flow; if the storage is to feed into the general distribution network, caution should be exercised before establishing a differential that may prove to be embarrassing when conditions change.

Capacity of Feeders

The decrease in the capacity of mains caused by incrustation or tuberculation is a matter of concern to all water works operators using ferrous metals in distribution systems. A 12-in. pipe having a Hazen-Williams coefficient of $C = 120$ when discharging 1.2 mgd. will discharge only 800,000 gpd. with the same head loss when $C = 80$—a decrease of $33\frac{1}{3}$ per cent in carrying capacity.

In 25 years of experience with steel and cast-iron pipe in distribution systems, the author has encountered few pipes of any considerable age which functioned at or near their original capacity unless they were lined with a material which prevented contact between the water and the metal. Of the exceptions, the most unusual was a 16-in. eleven-mile-long cast-iron supply line at Johnson City, Tenn., which, after 30 years of service handling a soft spring water, had a C value of 130.

Correction of pH alkalinity as practiced in most water plants serves to retard incrustation but rarely prevents it on unlined ferrous pipes. The author's practice is to specify cement linings on all cast-iron pipe and bituminous linings on large steel pipe. A thin cement lining, applied centrifugally and sealed with a bituminous

compound, appears to give satisfactory service and is usually furnished without additional cost by the manufacturer.

When a sudden increase in demand and a resulting drop in pressures occurs, a cleaning of the mains will often effect a quick improvement in conditions. In old systems, cleaning has often revealed that valves which no one knew existed were partially closed.

It should be noted, however, that although cleaning often solves immediate difficulties, it is not a permanent solution; sometimes the rate of incrustation after cleaning is even increased. If high velocities and reversals of flow cause sediment to be drawn into consumers' taps and the condition cannot be relieved by flushing, cleaning will often improve it.

Discussion

C. D. Lamon

Mgr., Water Works Board, Prichard, Ala.

The adequacy of water supply sources has been the subject of much study and investigation during the past few years. A related problem and one which demands equal attention is the current inability of many distribution systems to meet the growing water demands of the public. Distribution systems designed and constructed to meet the immediate needs of developing communities are proving inadequate to the demands of a growing population, new and expanded industrial processes and modern domestic and industrial appliances—such as air-conditioning equipment—which require large quantities of water.

Because the adequacy of a distribution system depends largely on its capacity to meet domestic, industrial and firefighting needs without incurring excessive pressure losses, the numerous supply mains, arteries and secondary feeders of the system must be of adequate size.

Water distribution is influenced by a number of factors, many of which vary from day to day or even from hour to hour. The determination of the total quantity of water needed for domestic and fire service generally involves so many unknown factors that a complete study of these would require an excessive amount of time and effort. Fortunately, satisfactory determinations of present and future requirements can be made simply and practically. The hydrant-flow test is the method most generally used to ascertain the maximum carrying capacity of a distribution system. By testing a small portion of the system at given intervals, both the pressure and the flow in an area can be determined. For the test to be of real value, pressure-indicating gages must be placed at a number of points.

Every well managed water works should be able to determine the quantity of "unaccounted-for water" in its distribution system. Although no definite water-loss figure can be set, if more than 25 per cent of the water distributed is unaccounted for, a leakage survey should be instituted. Pumping water into leaky mains and services is a costly and wasteful practice. Yet many managers still believe that, because all systems have leaks, a certain loss of water and revenue cannot be avoided. They also believe that the cost of surveying and repairing leaks is not warranted by the water saved.

Equipment for locating leaks is inexpensive. The aquaphone, for example, is a very good instrument for

testing services, fire hydrants and valves for water leaks of any size. Visual inspection of the storm sewers and natural drainage systems of the city is another economical and effective means of locating hidden leakage. Such inspections should be made during comparatively dry periods, when the natural runoff of water is at a minimum, and should be repeated semiannually, in the spring and fall. Leakage water entering the drainage system can usually be traced back to its source.

The quantity of unaccounted-for water can also be reduced by careful maintenance and repair of meters, with particular attention being given to the accuracy of registration at low flows. As water varies in its effect on meter registrations, each plant should adopt those time and registration limits for testing and calibrating meters which best suit its needs.

Study of the test records makes it possible to determine whether an additional line from the source of supply is necessary, whether extensions of existing arteries should be made or whether a strengthening of the general distribution system in a particular part of the city is all that is needed. Suitable locations for additional elevated storage can also be determined from the test records.

A comparison of the flows recorded will indicate whether important valves in the system have been left closed or whether tie-in or looped connections, although shown on system maps, have actually not been constructed. The internal condition of the various pipelines can also be determined by means of the flow test and by visual inspection. If heavy incrustations have formed, it has been found economically sound to remove them by cleaning the main in place. The cost of cleaning is only a fraction of the cost of digging up the line to clean or replace it. Cleaning a clogged main will usually increase its carrying capacity to about 95 per cent of its original capacity.

Continuous records are necessary for the compilation of information on consumption and unaccounted-for water. Water departments must keep such records and study them frequently if they are to plan to meet the growing demand for water.

Without water rate increases, it is difficult to see how water systems can continue to furnish service for existing needs and also meet the demand for extensions. Higher construction costs and shortages of materials have made it more difficult to improve and maintain distribution systems, particularly in rapidly growing communities.

Daily peak demands on a system can often be dealt with by adding a storage reservoir. An elevated tank or standpipe of ample capacity can be depended on to furnish a part of the peak demand, when it occurs, by automatically feeding stored water into the mains when pressure drops from line pressure losses. The stored water will equalize the load on the feeder line and will stabilize the supply pressure, preventing undue pressure fluctuations. It will also equalize the operation of the pumps, permitting greater efficiency, a higher load factor and lower power costs. The saving in power cost will be greater than if an extra-large pump had to be started daily for peak-load demands of short duration.

W. U. Quinby

Mgr., Water Works Board, Jasper, Ala.

The overloading of distribution systems is an operating problem which confronts every water works manager in the states of Alabama and Mississippi. This condition has grown stead-

ily worse during the past decade principally because of the phenomenal growth of our cities—which, even in normal periods, would have taxed the finances of some utility plants—and the continued upward curve of inflation.

When a city grows, its water facilities must expand to keep pace with it. Many cities installed small mains for this reason, even though the local managements realized at the time of installation that the mains would eventually be overloaded. It is difficult for water utility, however, to refuse to extend a 2 in. main to serve a growing area because a 6 in. main, known to be needed, cannot be afforded. Should the utility strain its finances to pay the additional cost of the 6 in. main needed for future expansion and fire protection? There appears to be no ready answer to this question.

The operators of public utilities have, of course, not been immune to the impact of inflation. Labor and material costs have shown substantial increases, putting the extension of large-size mains and storage facilities beyond the means of many water works. This condition is aggravated in some areas where, for selfish or political reasons, much-needed rate increases have been prevented. Some municipalities have dug deep into the profits of their water departments, overlooking the importance of setting up reserves for future planning and expansion.

If each municipal governing body or utility board would set aside part of its profits for replacement and extensions, the problem of financing additional feeder mains and storage facilities would be partially solved. Another factor in the overtaxing of distribution systems is the increase in per capita consumption of water over the nation. During the past fifteen years, the average person's water requirements have increased from 35 gpd. to approximately 55 gpd. For example, the population of Jasper, Ala., has increased approximately 18 per cent since 1940, whereas water consumption has increased more than 35 per cent.

It is the author's belief that air conditioning, homes with more than one bath, automatic washers and similar modern conveniences account for the major part of this disparity between the gains in population and water use. Serious consideration should be given to increasing the rates imposed on all air-conditioning units not using such conservation devices as recirculating towers. It is unfair to require a water utility to expand and maintain facilities to accommodate such a seasonal load.

From a practical business standpoint, the ideal solution to the supply and demand problem in water distribution is the adoption of and strict adherence to a master plan. Any growing property needs to anticipate the demands which will be imposed upon it and should be ready to meet them when the time comes. The manner in which the planning is carried out, however, and to some extent the scope of the planning, will be affected by the size of the property. If the utility is small and sufficient engineering talent is not available, competent consulting engineers can be retained to study the supply problem and set up a master plan that can be followed step by step. If the utility is reasonably large, trained men are probably available to set up future planning that will insure adequate feeder mains, loops and storage.

Master planning is an important phase of water works operation. The method of financing and carrying out the plans after they have been made, however, is a major problem to every citizen.

A Flow Regulator

By F. R. Georgia

A contribution to the Journal by F. R. Georgia, Supervisor, Water Works, Cornell Univ. Filter Plant, Ithaca, N.Y.

THE required flow of water through a filter plant is determined primarily by the sum of the settings of the rate controllers of the filters in service. The flow of raw water must be regulated to correspond to this demand at all times. This paper describes a completely automatic device developed at the Cornell University Filter Plant to accomplish this end.

The raw water flows by gravity from a small diversion dam in Fall Creek to a grit chamber in the plant and from there through a pipe to the flocculation basin. The flow regulator controls a sluice gate on the grit chamber end of the pipe. Excess water flowing to the grit chamber overflows a weir and is returned to the stream.

When the filter plant was built, a float controlled valve was put in the raw water pipeline between the grit chamber and the flocculation basin. This valve, which might have functioned properly with clear water, never gave satisfactory service on raw water because dirt accumulated in the valve and could not be removed unless the plant were shut down completely and the valve removed from the line. Careful cleaning did not result in any long period of satisfactory operation. For several years all attempts to use the valve were abandoned, and the flow was controlled by hand, until the automatic flow regulator was perfected and put into operation.

The flow from the flocculation basin to the filters is essentially an open-channel flow and probably is represented closely by the formula

$$Q = c\sqrt{h}$$

in which Q is the rate of flow, h the difference in elevation between the water levels in the flocculation basin and in the filters, and c is a constant which depends on the units used.

It was decided, in developing the regulator, to keep the water level in the flocculation basin constant and allow the level on the filters to vary with the flow. The function of the regulator is to translate water levels on the filters into valve openings that will maintain the proper rates of raw water flow at all times.

Design of Mechanism

A small chamber is connected to the filter influent line permitting the water level in the chamber to approximate that on the active filters. A cable running over a pulley wheel connects a float to a counterweight. Variations in the water level cause the float, acting through the cable, to turn the wheel, which is mounted on the shaft of a self-synchronous (Selsyn) motor over the float chamber (Fig. 1). The change in water level thus rotates the transmitting motor.

The transmitter is connected through a five-conductor cable to the matching self-synchronous motor at the regulator, which rotates with the one at the transmitter, always staying in phase with it. Although the torque exerted by such a motor is small, especially with small displacements, it can be used to control larger sources of power.

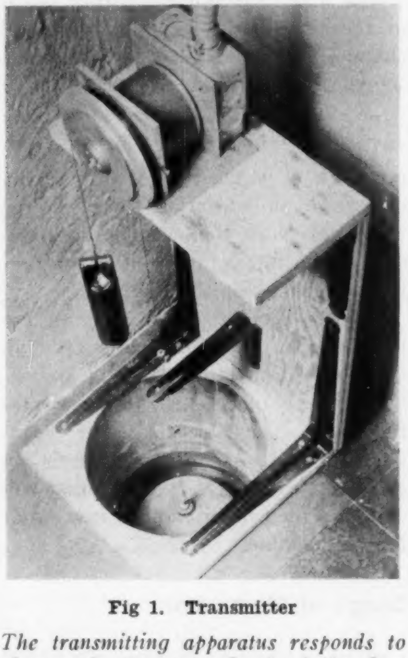


Fig 1. Transmitter

The transmitting apparatus responds to changes in the water level of the float chamber, which approximates the water level in the active filters, initiating contact with the regulator.

The actual flow of water is determined by the opening of a narrow, rectangular sluice gate. A gate of this type was used so that the flow would approximate a linear function of the gate opening. The gate is operated by means of a hydraulic cylinder, which, in turn, is controlled by a pilot valve (Fig. 2). The pilot valve is operated by the receiving self-synchronous motor through an auxiliary power device. A gear wheel on the receiver drives another identical gear, on which a special mercury switch is mounted, by means of a rack which rests on top of both gears. The gear which carries the mercury switch rests on another rack, which is connected to the piston of the pilot valve, and which can be moved in either direction by means of a special reversible motor controlled by the mercury switch.

If the water level on the filters changes, the transmitter will be rotated to correspond with the new level. The receiver will assume the same position as the transmitter and in so doing will roll the gear carrying the mercury switch, a highly sensitive single-pole double-throw center position "off" (Fig. 3). Rolling the gear, with the switch, from the center or "off" position, will "make" an electrical contact which will cause the reversible motor to drive the lower rack in a direction that will restore the gear and switch to the "off" position.

The movement of the lower rack, which is connected to the pilot valve piston, will cause the pilot valve to admit water to the hydraulic cylinder and thus start to open or close the sluice gate as required. Once initiated, the movement of the gate will continue until stopped by the restoration of the pilot valve to its neutral position. The valve is mounted on a track and is free to slide back and forth. A cable fastened to the end of the tell-tale rod of the hydraulic cylinder passes under a small pulley and around a larger wheel to a weight. The wheel is thus caused to rotate as the gate opens or closes. Fastened to its shaft is a cam; a cam follower is attached to the pilot valve, and a cord, running over a pulley to

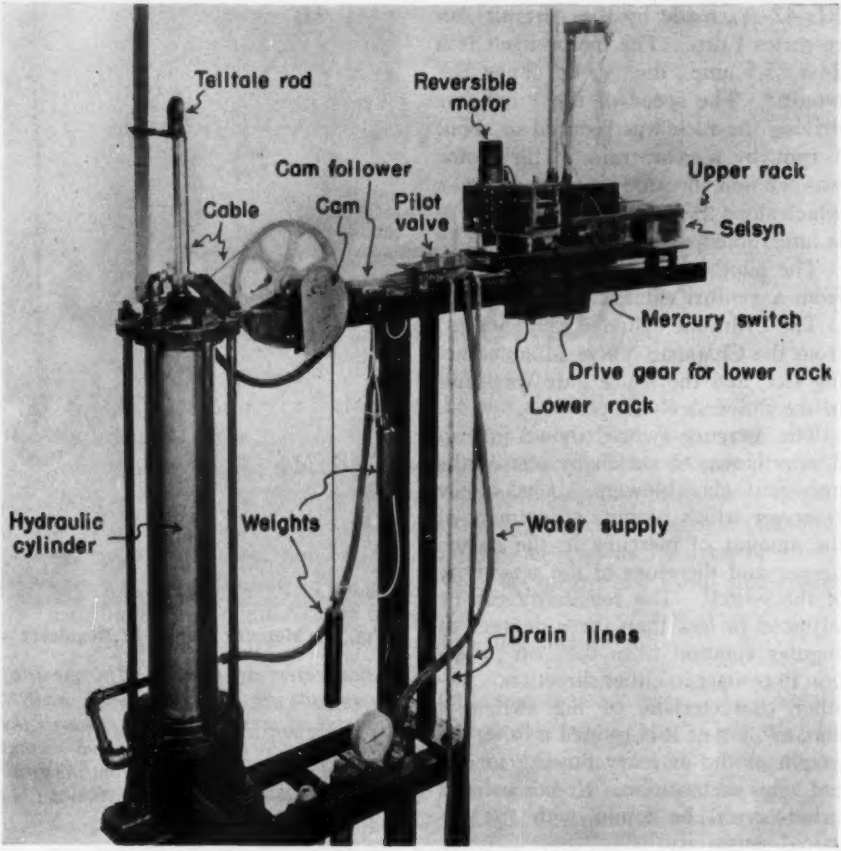


Fig. 2. Hydraulic Cylinder and Pilot Valve

The gate which determines the actual flow of water is operated by means of a hydraulic cylinder, in turn controlled by a pilot valve.

a weight, keeps the follower against the cam. The cam, which was calibrated experimentally, thus causes the pilot valve to move on its track until it is restored to its neutral position, at which point the sluice gate will have been opened or closed the proper amount. Water connections to the pilot valve and to the hydraulic cylinder are made through $\frac{1}{4}$-in. × $\frac{1}{4}$-in. rubber pressure tubing.

Equipment Components

A more precise description of some of the component parts of the apparatus follows:

The self-synchronous motors are 60-cycle, 115 v., a-c. Synchro Transmitters.*

The reversible motor was adapted from a U.S. Army Signal Corps Reel

* A product of the Bendix Aviation Corp., South Bend, Ind.

RL–42–A., made by the Aircraft Accessories Corp. The motor itself is a 24-v., 5.5 amp., d-c., $\frac{1}{15}$ hp. Type BA motor.* The speed of the 1 in. gear driving the rack was reduced to about 1 rpm. by a gear train. This motor was chosen because it has a brake which stops the drive the instant power is interrupted.

The pilot valve is a Type F valve † from a venturi effluent controller.

The hydraulic cylinder was obtained from the Chapman Valve Manufacturing Co., and the sluice gate was built in the university's shops.

The mercury switch, shown in Fig. 3, was blown to sketch by one of the university glass blowers. It has a side reservoir which permits adjustment of the amount of mercury in the switch proper and therefore of the sensitivity of the switch. The sensitivity can be adjusted to less than three degrees of angular rotation from the "off" position to contact in either direction. Another characteristic of the switch is that, as soon as it is rotated a little, the weight of the mercury flowing to one end helps the rotation. No commercial switch could be found with the required sensitivity.

The self-synchronous motors and the mercury switch are operated on 115-v., 60-cycle a-c. power. The mercury switch operates two relays controlling the 24-v., d-c. power supply to the reversible motor. The direct current is obtained by means of a transformer and rectifier from the alternating current line.

The device has functioned very well since May 5, 1950. The variation in flow appears to be less than two per cent of the total, with flows of approximately 1.5 mgd. Where manually controlled chemical feeders are in use, such close regulation of flow results in much greater uniformity of dosages. The regulator also relieves the operator of a time-consuming task—time which can be much better spent on other duties.

The flow regulator can be used to control flows if it is possible to use a throttling valve in the supply line. Such an arrangement would be especially useful on gravity supply lines.

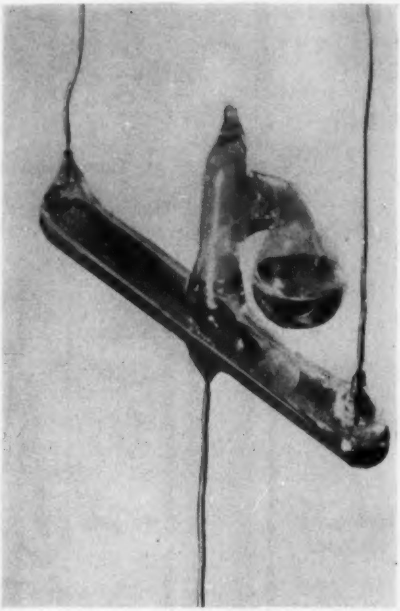
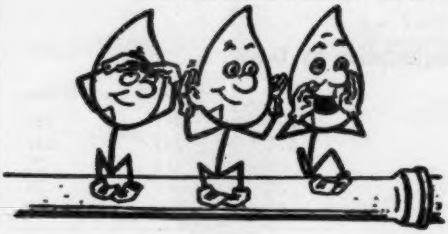


Fig. 3. Mercury Switch of Regulator

A side reservoir permits adjustment of the amount of mercury in the switch. The level of mercury in turn governs the sensitivity, which can be adjusted so that less than 3 deg. of rotation from the "off" position will give electrical contact in either direction.

* A product of General Electric Co., Schenectady, N.Y.

† A product of Builders Iron Foundry, Providence, R.I.



Percolation and Runoff

Scrap for Steel for Defense is the way the NPA puts it. Scrap for the Scrap is what they're talking about. Only those with very short memories need to be told now how important scrap is to defense production—and word that the flow of scrap is not keeping pace with needs ought to be enough to send you scrounging through your plant with a patriotic magnet. White elephant or old unfaithful, as long as it's iron or steel, it will be most helpful. And to get your scrap into the scrap just route it through your regular scrap dealer.

By all means, don't let old ironware just fade away.

My! and Ah Me! *Miami,* that is, now that it's over. And we-all really had a most enjoyable as well as profitable conference. Only trouble now is, a lot of us have developed a taste in vacations we aren't going to be able to, and a taste in sport shirts we aren't going to be allowed to, indulge. All of which may serve to suggest that this 71st annual waterspout was qualitatively, if not quantitatively, a complete triumph.

Never before, for instance, has a town been so absolutely plastered with signs to greet and guide us. Never has a local committee done a better job of arranging for weather and other natural beauties. Never have we had it so good vitaminically—with free orange juice, free coconuts and free sunshine all over the place. And never before have we been so directly aware and appreciative of southern comfort.

But don't suppose for a moment that the meeting was a statistical flop. Considering the fact that about 99 per cent of the customers had to come from only two basic directions and that most of them had to travel much greater distances to get there, Miami's 1,906 registration (just 101 short of the record) was well beyond all but our advertised expectations. Actually, even the definitely qualitative fact that 491 of the registrants were women was quantitative enough to establish a new feminine record, topping by 60 the former mark set four years ago in the breeze of another

(Continued on page 4)

CONFERENCE STATISTICS

(Story on p. 1)

Miami Registration by Days

Day	Men	Ladies	Total
Sunday, April 29	704	241	945
Monday, April 30	614	233	847
Tuesday, May 1	62	17	79
Wednesday, May 2	25	—	25
Thursday, May 3	10	—	10
TOTALS	**1,415**	**491**	**1,906**

Geographical Distribution of Registrants

UNITED STATES & TERRITORIES

Alabama	57
Arizona	9
Arkansas	11
California	89
Canal Zone	1
Colorado	10
Connecticut	17
Delaware	3
Dist. Columbia	18
Florida	192
Georgia	132
Hawaii	3
Illinois	139
Indiana	30
Iowa	28
Kansas	15
Kentucky	18
Louisiana	30
Maine	2
Maryland	22
Massachusetts	30
Michigan	36
Minnesota	31
Mississippi	2
Missouri	55
Nebraska	14
New Jersey	123
New Mexico	2
New York	172
North Carolina	53
North Dakota	6
Ohio	78
Oklahoma	9
Oregon	4
Pennsylvania	159
Puerto Rico	8
Rhode Island	16
South Carolina	25
South Dakota	6
Tennessee	39
Texas	56
Virginia	28
Washington	2
West Virginia	13
Wisconsin	39

CANADA, CUBA & FOREIGN

Brazil	1
Canada	29
Cuba	35
Dominican Republic	1
Mexico	4
Venezuela	4
TOTAL	**1,906**

Comparative Registration Totals—1942–1951

Year	Place	Men	Ladies	Total
1951	Miami	1,415	491	1,906
1950	Philadelphia	1,678	329	2,007
1949	Chicago	1,593	374	1,967
1948	Atlantic City	1,348	356	1,704
1947	San Francisco	1,115	431	1,546
1946	St. Louis	1,303	214	1,517
1944	Milwaukee	1,185	171	1,356
1943	Cleveland	973	158	1,131
1942	Chicago	1,198	240	1,438

Win, Place & Show in Section Awards

Henshaw Cup		Hill Cup		Old Oaken Bucket	
Canadian	**68.9%**	**Kansas**	**40.96**	**California**	**916**
Rocky Mt.	63.4%	Florida	34.82	New York	666
Montana	62.1%	Indiana	33.48	Southwest	617

(*Continued from page 1*)

ocean. And just how these quantities added up is shown in the "Conference Statistics" table on page 2.

Inside Dinner Key Exhibition Hall, which was first a Pan-American and later a Navy hangar, A.W.W.A. spent its days. A total of 16 sessions featuring 90 speakers kept members hurrying from meeting room to meeting room, joining in discussions with unprecedented interest. On the exhibit floor, 131 boothsful of the newest and best in water works ware was available for examination. And in the "Patio of the Sections," members could lounge between sessions and examine and vote on the 65 entries in A.W.W.A.'s seal contest displayed there. But wherever they hurried, argued, shoptalked, lounged or looked, people peeled off their jackets and loosened their ties or blossomed forth in the most flagrant sport shirts obtainable.

Nights were spent on the bay front, too, in Miami's Municipal Auditorium. There, on Monday night, Vic Weir and his fellow officers played hosts at the annual reception. There, on Tuesday night, Charlie Cox, Sam Morris and Shep Powell were presented with their certificates of Honorary Membership; Wendell LaDue received the Diven Medal; Prof. McIlroy took the Goodell Prize into pocket; and 25 new awardees were inducted into the George Warren Fuller Award Society. There, on Wednesday night, Bill Peck's variety show kept the crowd in good humor. And there, on Thursday evening, after giving the Hill Cup to the Kansas Section, the Henshaw Cup to the Canadian Section, the Old Oaken Bucket to the California Section and a change of tie and some fatherly advice to successor Al Berry, Vic Weir finally gave up the gavel, too, and bowed out after a most accomplishful year as President. All this to music and the singing of Jesse and Irene Russell, and then Al Berry's inauguration speech set everyone dancing.

But those were just two of the places which A.W.W.A.'ers patronized during conference week. There was also LaGorce Country Club on Miami Beach where the Manufacturers Golf Tournament was held and where, of 96 mug coveters, it was S. S. Gregory of Somerset, Ky., who copped the cup with a low gross of 85, while little Jack Hoerner of Atlanta took the peddler's prize with a gross of 80; and where Malcolm Hirsh of East Orange led the low netters with 71 and Mrs. Casey Jones led the ladies home with a gross of 103. There was Biscayne Bay and the ocean that played host not only to the ladies boat trip, but to hundreds of males headed for waters deeper and more saline than usual, therefrom to extract sundry tarpon, barracuda, tuna, sailfish (Frank Amsbary and Al Wieter (a nine-footer) (the fish)) and even shark (Charlie McArthur (a 200-pounder with an ulcer) (still the fish)). There was Crandon Park for the fashion show and for swimming. There was Miami Beach for sightseeing, shop-

(*Continued on page 6*)

(*Continued from page 4*)

ping and lots of good eating. There was Room 741 at the McAllister, where bridge burgeoned. And there was even the dog track, where Alex Smolenski of Hamtramck, Mich., put two bucks on the daily double and raked in $150, which he immediately invested in another week of Miami. Of course he wasn't the only one who tried to help Kefauver clean up in Dade County. There was, for instance, Dana Kepner who won the five-dollar prize in the contest for the loudest sport shirt on the Board of Directors. And then Fred Merryfield, who walked off with $55 in the Directors' attendance pool.

Thus we come to praising Caesar, having previously buried him—for it was Caesar Wertz, as chairman of the Convention Management Committee, who was buried in details for months ahead of time and whose self-disinterment was of primary importance to the success of the whole affair. And flanking Caesar in putting the program across were such stalwarts as Sig Sigworth, Tom Quigley, Charlie Capen, Bill Glass, Dave Lee, Keith Keller and a hundred or more local section workers who did their duty behind the scenes. The *"My!"* and *"Ah Me!"* are as much theirs as ours, we're sure, at seeing another conference successfully completed.

As for next year, we'll expect to be barely seen behind some Kansas City steak.

Speaking of next year, though, reminds us to point out that not just the officers buttered up in these columns last month, but a whole flock of new directors also took office on the last day of the Miami meeting. For the next year, the freshman third of the Board will include:

California Section—Morris S. Jones, chief engineer and general manager, Water Dept., Pasadena. True to tradition, this Californian was born elsewhere—in Cedar Rapids, Iowa—but he settled in Pasadena early enough to receive his education there, and he attended the University of California, from which he received the B.S. degree in civil engineering in 1911.

The following year, in the capacity of hydrographer, he joined the U. S. Bureau of Reclamation, working on the Strawberry Valley project. With the City Engineer's office in Los Angeles in 1912–1913, he returned to Pasadena in the latter year to become assistant chief engineer of the water department, assuming his present post in 1935.

Jones was vice-chairman of his section in 1941 and chairman in 1942.

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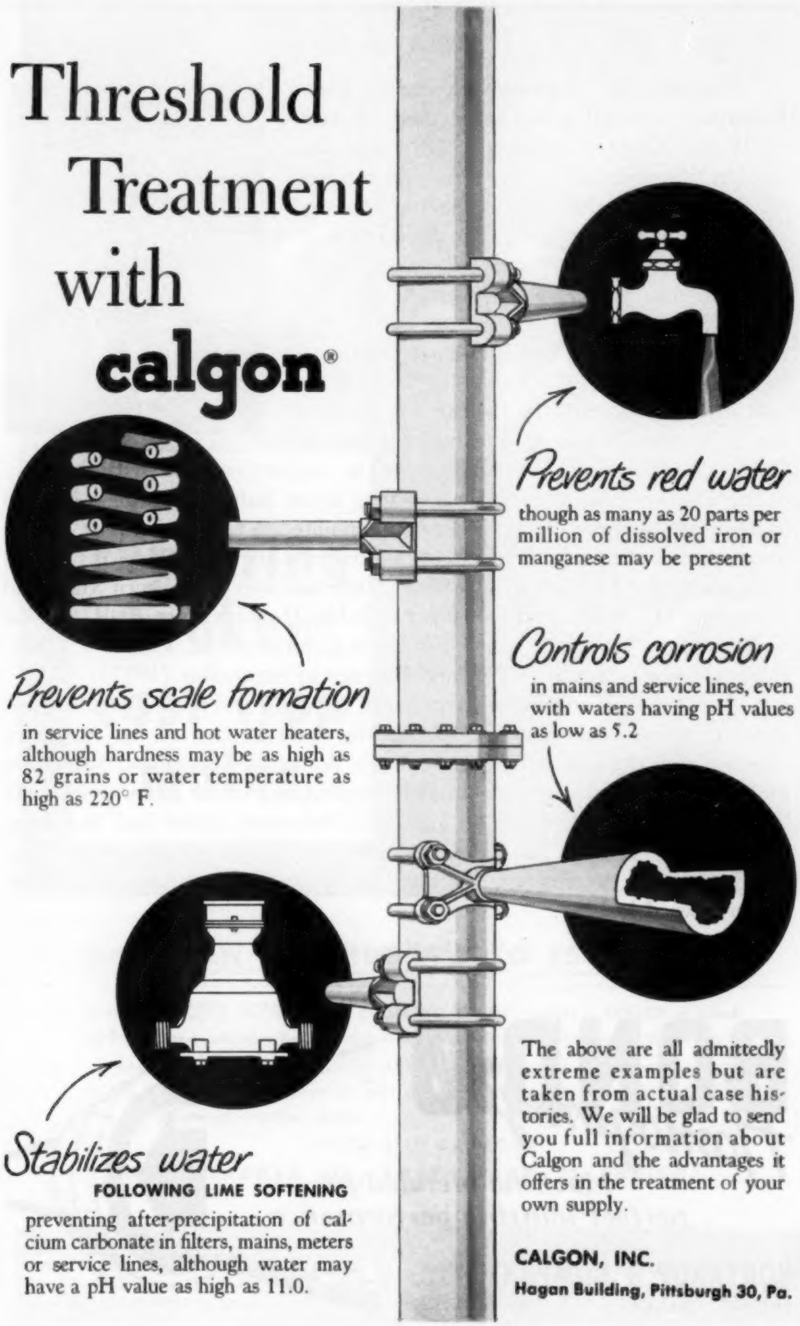
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Prevents red water
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in service lines and hot water heaters, although hardness may be as high as 82 grains or water temperature as high as 220° F.
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(Continued from page 6)

Chesapeake Section—Edward Scott Hopkins, principal associate engineer, Bureau of Water Supply, Baltimore, Md. He was born in Aberdeen, Md.—in 1896—and received his education in that region, having attended Johns Hopkins University, the University of Maryland and Georgetown University. He is a registered professional engineer in four states.

In the service of the Baltimore Bureau of Water Supply from 1923 to 1942, he held the post of principal sanitary chemist for the first fourteen years, becoming filtration engineer in 1937. During World War II he served as sanitary engineer with the army in the Third Service Command, returning to the Baltimore Bureau in 1946 as associate engineer. In 1948 he was appointed to his present post. Academic posts he has held include that of lecturer at the Johns Hopkins School of Hygiene and Public Health (1933–1935) and also at Western Maryland College (1935–1940), and instructor at Johns Hopkins since 1949. Books he has written include *Water Purification Control* (1932, 1936 and 1948), *Elements of Sanitation* (1937) and *Practice of Sanitation* (1951).

Active and prominent in a number of technical and professional organizations, he has been chairman of the Maryland Section of the American Chemical Society and also of the society's Water, Sewerage and Sanitation Division and its committee on standard methods for water and sewage. He has also been president of the Maryland-Delaware Water and Sewerage Assn. In the A.W.W.A., which he joined in 1921, he was chairman of the old Four States Section and was the Chesapeake Section's nominee for the Fuller Award in 1949.

(Continued on page 10)

(*Continued from page 8*)

Cuban Section—Luis Alberto Nunez, head professor of hydraulics and heat engines at the University of Havana and consulting hydraulic engineer. A graduate of Havana Institute in 1919, he received the civil engineering degree from the University of Havana in 1924 and that of architect a short while later.

Engaged in construction work for two years, he became assistant professor at the university in 1927, simultaneously becoming chief of its Hydraulic and Heat Engine Laboratories. In 1940 he became head professor and director of the laboratories. In addition to a number of papers and monographs on hydraulics, he has written several books on hydraulics and the kinematics of machines and heat engines.

A past director of the Cuban Section of A.W.W.A., he has also been president of the Civil Engineer Section of the School of Engineers of the University of Havana and a member of the Cuban Society of Civil Engineers and of other societies.

Florida Section—Claude F. Wertz, resident engineer with Day and Zimmermann, Philadelphia consultants, assigned to the Miami Dept. of Water and Sewers. Born in Reading, Pa., in 1898, he attended Pennsylvania State College, receiving the degree of B.S. in Sanitary Engineering in 1920. He is a registered professional engineer in Pennsylvania and Florida.

After leaving college he joined the Pennsylvania State Board of Health, serving as assistant engineer for a six-year period. In 1926 he became principal assistant engineer with the Philadelphia office of the consulting firm of Fuller & McClintock. There followed a succession of connections with consultants—George B. Gascoigne & Assoc., Cleveland; Nichols Engineering & Research Corp., New York; private practice in New York; Fuller & McClintock again (this time in New York); Havens & Emerson, New York; and, finally, the property management post he has occupied since 1941.

Wertz has been vice-chairman, chairman and Fuller Award recipient of the Florida Section; he has also worked on various national committees. The scope of his interests is attested to by membership in a host of national and regional engineering organzations.

(*Continued on page 14*)

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Illinois Section—F. G. Gordon, assistant city engineer of Chicago. Born at Fort Collins, Colo., in 1891, he obtained the A.B. degree in municipal and sanitary engineering from the University of Illinois in 1912. He is a registered professional engineer in Illinois and Iowa, and a registered structural engineer in Illinois.

Upon leaving school he served for five years with Dabney H. Maury, consulting engineer, in the capacity of assistant engineer. World War I found him in the Army's Construction Div. After a brief interval with the Standard Oil Co. (Ind.), he returned, as principal assistant, to the Maury organization, which later became known as Maury & Gordon. Still later his firm was known as Gordon & Bulot, and then, from 1924 to 1941, as F. G. Gordon. Since 1941 he has been associated with the Chicago Dept. of Public Works.

A member of A.W.W.A. since 1921, Gordon has been chairman of his section. He is also a member of the American Society of Civil Engineers, of the Western Society of Engineers and of the American Public Works Assn.

Michigan Section—Earl E. Norman, manager of City Light and Water Utilities, Kalamazoo. Born in Three Rivers, Mich., in 1893, he received the B.S. degree in electrical engineering from the University of Michigan in 1917. He is a registered professional engineer in Michigan.

While still attending school he was employed as a troubleshooter and power plant operator by what is now the Detroit-Edison Co. After his graduation, he joined the General Electric Co., and remained with that organization—first in the testing, then in the engineering department—for five years. In 1922 he accepted an offer to assume the position he has held ever since with the city of Kalamazoo.

Norman's society affiliations include membership in the Michigan Engineering Society, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the Michigan Municipal Utilities Assn. He has been chairman of his A.W.W.A. Section.

(Continued on page 16)

(*Continued from page 14*)

Minnesota Section—Ross A. Thuma, superintendent of the Filtration Plant of the St. Paul Water Dept. Born in Perry Township, Ohio, in 1884, he attended Otterbein College, from which he received the B.S. degree in 1911, and the University of Minnesota (M.S. 1915). He is a licensed professional engineer in Minnesota.

After a brief period teaching science in an Iowa high school, he became a chemist for the Great Northern Railroads Co., occupied with the investigation of soils. From 1915 to 1917, again in the capacity of chemist, he was with the Minnesota Experiment Station, leaving to become a chemist with a wholesale and manufacturing drug concern. He served in the Sanitary Corps during World War I, returning to Minnesota to do public health work in the dairy and food fields for the state. He joined the St. Paul Water Dept. in 1920, and, except for an interval with the Corps of Engi-

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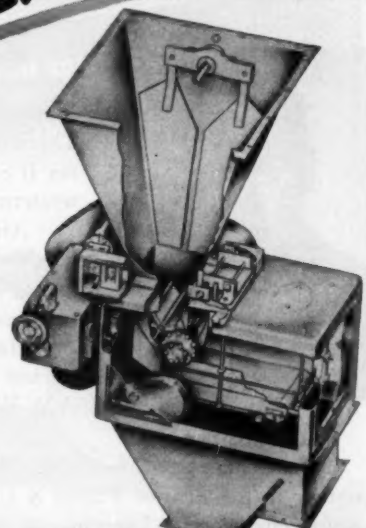
IT'S THE "LAST WORD"!



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(*Continued from page 16*)

neers during World War II, he has remained with that department ever since.

This is Thuma's second term as A.W.W.A. Director, as he served a term in 1941–42. He has also been chairman of his section and chairman of the Minnesota Water Works School, as well as being active in a number of committee assignments and other professional and technical organizations.

Montana Section—John B. Hazen, superintendent, Butte Water Co., Butte. Born in Douglas, Wyo., in 1907, he was raised in Thermopolis, in the same state. He received his B.S. degree in civil engineering at Northwestern University, Evanston, Ill., in 1929.

After leaving school he joined the Mining Engineering Dept. of Anaconda Copper Mining Co. at Butte, Mont., leaving in 1930 to accept his present position with the Butte Water Co.

Hazen has been a trustee of the Montana Society of Engineers and was chairman of his A.W.W.A. Section in 1948.

Nebraska Section—John W. Cramer, partner in the firm of Fulton & Cramer, consulting engineers of Lincoln. A native of the state, he was born in North Platte, Neb., on May 15, 1914, and was raised in that community. Schools attended include Wentworth Military Academy for junior college training and the University of Nebraska, from which he received the B.S. degree in civil engineering in 1940. He is a registered professional engineer in the states of Nebraska and South Dakota.

Shortly after leaving junior college, Cramer went to work for the Platte Valley Public Power and Irrigation Dist., North Platte, in the capacity of clerk. He resumed his studies three years later at the University of Nebraska. After his graduation, he took a position with the Vega Aircraft Corp. in Burbank, Calif., as draftsman, detailer and layout man. In 1942 he joined the firm of Davis & Wilson in Denver, Colo., as deputy chief engineer. A year later, he was back in Burbank, Calif., this time as fuselage design engineer for Lockheed Aircraft Corp. In 1944 he became chief engineer of the Chemold Co., a division of Western Plastics, Inc., in Glendale, Calif. He

(*Continued on page 20*)

(*Continued from page 18*)

organized his consulting firm in 1945 and has had a general municipal practice since.

A member of many professional and technical societies, Cramer was secretary of his A.W.W.A. section from 1948 to 1950.

Ohio Section—A. A. Ulrich, vice-president and member of the Board of Directors of the Ohio Water Service Co., and manager of the Massillon Dist. Born in Massillon in 1904, he attended Wittenberg College in Springfield, Ohio, obtaining the B.S. degree in 1929.

After two years with the Midwest Div. of the Federal Water & Gas Corp. in Ohio, Illinois and West Virginia as meter technician in charge of meter repair and the training of meter mechanics, he joined the Ohio Water Service Co. as superintendent of its Massillon Plant. In 1936 he became manager of the Massillon Dist. and was elected to the Ohio Water Service Co. board. His election to the vice-presidency of the company occurred in 1945.

Ulrich has been a member of A.W.W.A. since 1931. He has been a member of the Ohio Section's Board of Trustees as well as its vice-chairman and, in 1950, chairman.

Southwest Section—Edward R. Stapley, dean, Oklahoma Inst. of Technology of the Oklahoma A.&M. College, Stillwater, Okla. Born in Geneseo, N.Y., in 1889, he attended the High School Dept. of Geneseo State Normal School, being graduated in 1910. Further degrees received include the C.E. (1914) and M.C.E. (1930) from Cornell Univ. and S.M. in sanitary engineering (1939) from the Graduate School of Engineering at Harvard Univ.

Beginning his career in 1913 as a draftsman, he next became assistant city engineer for Ithaca, N.Y., at the same time taking up the duties of an instructor in civil engineering at Cornell. In 1916 he became resident engineer for Anderson and Christie, consultants of Wilson, N.C. After a period of service with various branches of the army during World War I, he accepted a post as assistant manager and secretary-treasurer with the Geneseo Automobile Co. A brief connection with the Sterling Salt Co.

(*Continued on page 22*)

(Continued from page 20)

was followed, in 1925, by his association with Oklahoma A.&M. College, which he has maintained ever since. At first associate, then full professor and acting head of civil engineering, he was appointed to his present post as dean—at first in an acting capacity—in 1942.

In addition to his regular activities, he has had a consulting practice and has written numerous articles on water, sewage, sanitation and education. Among the more prominent of his many professional and technical affiliations and activities may be counted the presidency of the Oklahoma Section of the American Society of Civil Engineers, membership in the American Society for Engineering Education, in which he was also chairman of several committees, and the chairmanship of the Committee on Ethics and Professional Practice of the Oklahoma Society of Professional Engineers. In A.W.W.A. he has been chairman of the Goodell Award Committee, trustee, vice-chairman and chairman of the Southwest Section, as well as that section's Fuller Award recipient.

Manufacturer—Reginald F. Hayes, vice-president and general sales manager, Hydraulic Development Corp., New York, N.Y. A native of Rochester, N.H., where he was born in 1901 and received his early education, he later attended Bowdoin College in Brunswick, Me., completing his studies in 1923.

Back in New Hampshire, he entered the manufacturing field and was connected with a shoe manufacturing firm in Rochester until 1928, when he left to begin his association with the Hydraulic Development organization.

Hayes has been a member of the Board of Governors and is a past-president of the Water & Sewage Works Manufacturers Assn.

(Continued on page 64)

Membership Changes

NEW MEMBERS

Applications received April 1 to 30, 1951

Allison, William R., *see* Washington (Ind.) Water Works

Anderson, Frank W., Mgr., Dept. of Purchase, Stores & Transportation, Metropolitan Utilities Dist., 18th & Harney Sts., Omaha 2, Neb. (Apr. '51)

Andrews, R. S., Sr. Partner, Andrews Chem. Co., 420 Broad St., Utica, N.Y. (Apr. '51) *P*

Arango de Varona, Eduardo, Public Health Engr., Ministerio de Salubridad, Seccion de Ingenieria Sanitaria, Ave. Estrada Palma 54, Camaguey, Cuba (Apr. '51) *P*

Armand y Ramos Izquierdo, Antonio, Director de Acueductos y Alcantarillados, Com. de Fomento Nacional, 1258 Calle 23, Vedado, Havana, Cuba (Apr. '51) *PR*

Armstead, Robert E., *see* Zia Co., The

Baker, Earl W., Utilities Co., A. W. Smalley, Jr., Mgr., Box 200 W, Oklahoma City, Okla. (Corp. M. Apr. '51)

Barnum, William J., Dist. San. Engr., State Dept. of Health, 601 Hotel Jamestown Bldg., Jamestown, N.Y. (Jan. '51) *P*

Beatie, Russel H., Mgr., Chem. Div., Reid Supply Co., 306 W. 2nd, Wichita, Kan. (Apr. '51) *P*

Becker, E. B., Acting Water Plant Supervisor, West Palm Beach Water Co., 704 Ardmore Rd., West Palm Beach, Fla. (Apr. '51) *MP*

Black, Ralph J., Asst. San. Engr., Bur. of San. Eng., State Dept. of Public Health, 703 State Bldg., 217 S. 1st St., Los Angeles 12, Calif. (Apr. '51) *P*

Blissfield Munic. Water Works, Fred Pagel, Blissfield, Mich. (Corp. M. Apr. '51) *MPR*

Blunk, Harry C., Supt., Water Dist. No. 20, 1822 S. 120th St., Seattle 88, Wash. (Apr. '51) *MR*

Bocken, George N., Supt. of Distr., Dept. of Water Works, 5941 Calumet Ave., Hammond, Ind. (Apr. '51) *M*

Bogert, Ivan L., Partner, Clinton L. Bogert Assocs., 624 Madison Ave., New York, N.Y. (Apr. '51)

Boonville Water Dept., Onis G. Rudolph, Mayor, City Hall, Boonville, Ind. (Corp. M. Apr. '51)

Bordelon, H. E., Chief Engr., State Hospital, State Hospital, Ark. (Apr. '51)

Brown, Barney, Supt., Munic. Water System, Hot Springs, Ark. (Apr. '51)

Bunn, John F., Jr., *see* Dallas (Pa.) Water Co.

Burt, James Robert, Asst. Supt. & Chemist, Water Plant, Wauseon, Ohio (Apr. '51) *MP*

Campbell, Elmer W., *see* Maine Dept. of Health & Welfare

Campbell, Vincent, *see* South Sioux City (Neb.)

Celanese Corp. of America, H. L. Kyle, San. Engr., Box 1001, Rock Hill, S.C. (Corp. M. Apr. '51) *MPR*

Center, Herbert, Supt. of Utilities, Box 114, Bushnell, Fla. (Apr. '51) *MP*

Chouteau, Ed, Water Plant Supt., East Route, Nowata, Okla. (Apr. '51) *P*

Claridge, R. E., Power Equipment Sales, D. M. Fraser Ltd., 54 Lombard St., Toronto 1, Ont. (Apr. '51)

Code, Robert G., Cons. Engr., 799 Adelaide St., N., London, Ont. (Apr. '51) *MPR*

Crandall, Clarence W., Well Drilling Contractor, Pine City, N.Y. (Apr. '51) *R*

Crane, Frederick W., Comr. of Public Works, 502 City Hall, Buffalo 2, N.Y. (Apr. '51) *M*

(*Continued on page 32*)

(*Continued from page 30*)

Crenshaw, Clarence W., Mgr., Oil City Welding Works, Lake Charles, La. (Apr. '51)

Culler, Ramsey B., Comr. of Public Works, Bradenton, Fla. (Apr. '51) *R*

Dallas Water Co., John F. Bunn, Jr., Pres., Dallas, Pa. (Corp. M. Apr. '51) *MR*

Derse, Art J., Repr., Badger Meter Mfg. Co., Box 671, Columbus, Ohio (Apr. '51)

Devereaux, William A., Branch Mgr., Bailey Meter Co., Ltd., 501 Bank of Nova Scotia Bldg., Halifax, N.S. (Apr. '51)

Devlin, F. E., Cons. Engr., 4005 E. Kellogg, Wichita, Kan. (Apr. '51) *PR*

Etnire, Ben S., Supt., Water Dept., Augusta, Kan. (Apr. '51)

Fernandez Mira, Armando, Sub-Director de Acueductos y Alcantarillados, Com. de Fomento Nacional, Avda. 11 entre Calle 10 y Calle 11, Ampliacion de Almendares, Havana, Cuba (Apr. '51) *PR*

Fiero, Howard F., Supt., The Cairo Water Co., Cairo, N.Y. (Apr. '51) *MPR*

Fincannon, George A., Supt. of Waterworks, Brooksville, Fla. (Apr. '51) *MP*

Forrester, H. G., *see* Titusville (Fla.) Water Dept.

Fuentes Ferrer, Ramon, Public Health Engr., Ministerio de Salubridad, Seccion de Ingenieria Sanitaria, 302 Calle B, Apt. 2, Rpto. Almendares, Marianao, Cuba (Apr. '51) *MP*

Gentry, Ted, Repr., Badger Meter Mfg. Co., 518 E. 8th St., Little Rock, Ark. (Apr. '51)

Gilbert, Kenneth, Sales Mgr., Layne-Arkansas Co., Stuttgart, Ark. (Apr. '51) *R*

Godshall, Donald A., Sr., City Engr. & Water Supt., 105 N. Market St., Port Hueneme, Calif. (Apr. '51) *M*

Goldbach, Alfred B., Owner, Henry Sundheimer Co., 103 Park Ave., New York 17, N.Y. (Apr. '51)

Gough, Harry P., Asst. City Clerk & Treas., City Hall, Fredericton, N.B. (Apr. '51)

Gruenberg, Asher S., Designer, Bur. of Advance Sewer Planning, 188 W. Randolph St., Chicago, Ill. (Apr. '51) *PR*

Gurtlinger, John J., Dist. Sales Repr., Inertol Co., Inc., 1645 Research Ave., Newark, N.J. (Apr. '51)

Gwin, Bruce, Supt., Munic. Water Dept., Sheridan, Ark. (Apr. '51)

Haag, Orville Herschel, Contracting Engr., Consolidated Western Steel Corp., 141 Battery St., San Francisco, Calif. (Apr. '51)

Haagenson, Nels F., Asst. Supt., Water & Light Dept., Fergus Falls, Minn. (Apr. '51) *MPR*

Harvey, Raymond E., Price Clerk, Grinnell Co. of the Pacific, 6121 Hollis St., Emeryville, Calif. (Apr. '51) *M*

Hertel, Raymond M., Assoc. San. Engr., State Dept. of Public Health, 710 State Bldg., Los Angeles, Calif. (Apr. '51) *P*

Holloway, J. H., Field Engr., Fairbanks, Morse & Co., 6111 Prospect Ave., Kansas City, Mo. (Apr. '51)

Ireland, Norvel E., Repr., Louis H. & K. J. Collar Co., 1913 Tauromel Ave., Kansas City, Kan. (Apr. '51)

Johnson, D. D., Supt., Light & Water Dept., Paris, Ark. (Apr. '51)

Kelly, John Claude, Supt., Oil City Welding Works, Box 701, Lake Charles, La. (Apr. '51)

Kern, Kasper, Water Service & Mains Foreman, Los Angeles Dept. of Water & Power, 5444 Buffalo Ave., Van Nuys, Calif. (Apr. '51)

Kyle, H. L., *see* Celanese Corp. of America

Lamb, Clarence Francis, Civ. Engr. & Partner, Waterman Eng. Co., 86 Weybosett St., Providence, R.I. (Apr. '51) *MR*

Lankford, Marlowe H., City Engr., Ulysses, Kan. (Apr. '51) *MPR*

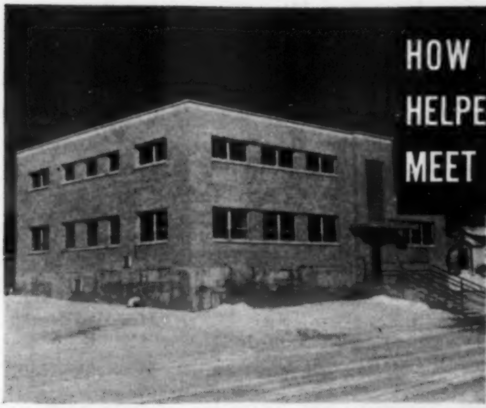
Larsen, Herman, Vice-Pres., P. C. Sorenson & Co., Inc., 4516 Fairfax Ave., Dallas 5, Tex. (Apr. '51)

La Verne, City of, E. R. Snell, City Supt., 2061—3rd St., La Verne, Calif. (Corp. M. Apr. '51) *MPR*

Le Blanc, Rene A., Dist. Mgr., Wallace & Tiernan Co., Inc., 1411 Crescent St., Montreal 25, Que. (Apr. '51)

Lieberman, Morton W., Cons. Engr., East Nassau St., Box 222, Princeton, N.J. (Apr. '51) *MPR*

(*Continued on page 34*)



(*Continued from page 32*)

Maine Dept. of Health & Welfare, Elmer W. Campbell, Director, Div. of San. Eng., 231 State St., Augusta, Me. (Corp. M. Apr. '51) *P*

Miller, Robert S., Asst. Dist. Engr., State Div. of Health, 407 Cedar St., Washington, Mo. (Apr. '51) *MPR*

Miller, Thomas G., Jr., Asst. to Supt. of Public Works, 219 S. Albany St., Ithaca, N.Y. (Apr. '51) *MP*

Moehlman, Roger, San. Engr., Harris County Health Unit, Box 4104, Houston, Tex. (Apr. '51) *MPR*

Monson, W. M., *see* Ulysses (Kan.)

Montoulieu, Enrique J., Jr., Civ. Engr., La Tropical Brewery & Ice Plant, Calzada de Columbia y San Agustin, Maianao, Havana, Cuba (Apr. '51) *MPR*

Muldoon, Anthony A., Gen. Mgr., Mountain State Water Co., Mullins Bldg., Buckhannon, W. Va. (Apr. '51) *MP*

Osborne, Jesse Lee, Branch Mgr., Viking Supply Corp., 722 W. Broadway, North Little Rock, Ark. (Apr. '51)

Pagel, Fred, *see* Blissfield (Mich.) Munic. Water Works

Panzica, Nicholas, Supt. of Waterworks, Peru, Ill. (Apr. '51) *P*

Paoli, Town of, John T. Roll, Paoli, Ind. (Corp. M. Apr. '51) *MPR*

Pascoe, Walter Robert, Research Engr., Atlas Mineral Products Co., Mertztown, Pa. (Apr. '51) *M*

Perez de Morales, Eduardo, Public Health Engr., Ministerio de Salubridad, Seccion de Ingenieria y Arg. Sanitaria, San Miguel 30, Santa Clara, Cuba (Apr. '51) *MPR*

Prestage, Niles A., Supt., Utilities Branch, Ordnance Corps, Redstone Arsenal, 602 Bierne Ave., Huntsville, Ala. (Apr. '51) *MP*

Quadreny Garcia, Jorge L., Public Health Engr., Ministerio de Salubridad, Seccion de Ingenieria y Arg. Sanitaria, 459 Calle B, Apt. 23, Vedado, Havana, Cuba (Apr. '51) *MP*

Rapides Parish Waterworks Dist. No. ***3,*** Lester A. Smith, Pres., Box 212, Pineville, La. (Corp. M. Apr. '51)

Richey, Curtis E., Public Health Engr., U.S. Public Health Service, 441 Federal Office Bldg., San Francisco, Calif. (Apr. '51) *R*

Riemer, Henry, Mgr., Bexar Metropolitan Water Dist., Box 25, San Antonio 11, Tex. (Apr. '51) *M*

Roll, John T., *see* Paoli (Ind.)

Rook, Carl H., Supt., Municipal Utilities, Pleasant Hill, Mo. (Apr. '51)

Rudgal, Harold T., Vice-Pres. & Mgr., Gary-Hobart Water Corp., 545 Broadway, Gary, Ind. (Apr. '51) *MP*

Rudolph, Onis G., *see* Boonville (Ind.) Water Dept.

Russell, City of, J. H. Wigglesworth, City Mgr., Russell, Kan. (Corp. M. Apr. '51)

Schiesswohl, Donald Phillip, San. Engr., Bur. of San. Eng., State Board of Health, Box 210, Jacksonville, Fla. (Apr. '51) *P*

Schilling, Henry, Power Plant Engr., Gen. Aniline & Film Corp., Box 82 Rensselaer, N.Y. (Apr. '51) *PR*

Schlindler, Richard O., Public Health Engr., Rensselaer County Health Dept., 5 Elizabeth St., Troy, N.Y. (Apr. '51)

Sebeste, Flavius J., Asst. Tech. Director, Culligan Zeolite Co., Northbrook, Ill. (Apr. '51) *P*

Shull, Ivan F., San. Engr., State Board of Health, Marvin Hall, Univ. of Kansas, Lawrence, Kan. (Apr. '51) *MP*

Shurtleff, Art, Repr., Rockwell Mfg. Co., 216 S. Jamestown Ave., Tulsa 12, Okla. (Apr. '51)

Simon, Ernest Louis, Supt., Water & Light Dept., Virginia, Minn. (Apr. '51) *MP*

Smalley, A. W., Jr., *see* Baker, Earl W., Utilities Co.

Smith, Lester A., *see* Rapides Parish Waterworks Dist. No. 3

Snell, E. R., *see* La Verne (Calif.)

South Sioux City, City of, Vincent Campbell, City Hall, South Sioux City, Neb. (Mun. Sv. Sub. Apr. '51)

Spitler, Cecil Stuart, Sales Repr., Well Machinery & Supply Co., 8822 Redondo Dr., Dallas 18, Tex. (Apr. '51)

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Stall, John Byron, Asst. Engr., State Water Survey Div., Box 232, Urbana, Ill. (Apr. '51) *R*

Steele, Robert William, Cons. Engr. & Partner, Owen, Mansur & Steele, 1642 S. Boston, Tulsa, Okla. (Apr. '51) *PR*

Strasser, John J., Sales Repr., The Hersey Mfg. Co., 830 N. Wabash Ave., Chicago, Ill. (Apr. '51)

Swaim, John P., Salesman, Diamond Alkali Co., 306 W. 2nd St., Wichita 2, Kan. (Apr. '51) *MPR*

Talbot, Leland A., City Engr., Greenleaf, Kan. (Apr. '51) *MR*

Thompson, John C., Exec. Engr.-Secy., State Water Power & Control Com., 110 State St., Albany, N.Y. (Apr. '51) *R*

Tiernan, Pat, Tiernan Eng. Co., 131½ S. Side Square, Macomb, Ill. (Apr. '51) *MPR*

Titusville Water Dept., H. G. Forrester, City Mgr., City Hall, Titusville, Fla. (Mun. Sv. Sub. Apr. '51) *MPR*

Tobin, Edward J., Mgr., Water Works No. 2, 104 N. Utica St., Waukegan, Ill. (Apr. '51) *M*

Ulysses, City of, W. M. Monson, Comr. of Public Works, City Hall, Ulysses, Kan. (Corp. M. Apr. '51) *MPR*

Washington Water Works, William R. Allison, Office Mgr., City Hall, Washington, Ind. (Corp. M. Apr. '51) *M*

Weatherford, Edmund C., Chemist, Main Sewer Dist. No. 1, Mission, Kan. (Apr. '51) *P*

Weber, Henry N., Supt. of Water Dept., 5137 Oakton St., Skokie, Ill. (Apr. '51) *M*

West, Cornie M., Chief Operator, Anna State Hospital Plant, 102 Lincoln St., Anna, Ill. (Apr. '51)

Wigglesworth, J. H., *see* Russell (Kan.)

Younger, Anthony, Water Supt., City Hall, Hays, Kan. (Apr. '51) *PR*

Zia Co., The, Robert E. Armstead, Supt., Utilities Section, Water Distr., Los Alamos, N.M. (Corp. M. Apr. '51) *MPR*

Zieserl, John F., Sales Repr., Industrial Chem. Sales Div., West Virginia Pulp & Paper Co., 35 E. Wacker Dr., Chicago 1, Ill. (Apr. '51) *P*

REINSTATEMENTS

Ajzenberg, Yisrael, Water Works Engr., Box 631, Tel Aviv, Israel (Jan. '45)

Brisset des Nos, Andre, Asst. Div. Engr., Aqueduct Sec., City of Montreal, 3161 Joseph St., Verdun, Montreal 19, Que. (Jan. '48)

Chandler, R. B., Mgr., Public Utilities Com., Public Utilities Bldg., Port Arthur, Ont. (Jan. '43)

Kaufman, A. A., City Engr., Water Dept., W. Charles St., Humboldt, Kan. (Jan. '47)

Kuran, Orville G., Supt., Water Distr.-Mains, Board of Public Utilities, 10th & Muncie, Kansas City, Kan. (Jan. '48) *M*

Michaels, A. P., Cons. Engr., A. P. & R. K. Michaels, 202 Church-Main Bldg., Orlando, Fla. (Aug. '24) *Director '31–'33.*

Simmonds, Ian G., Asst. Chem. Engr., Ontario Dept. of Health, 807 Richmond St., W., Toronto, Ont. (July '45)

Striger, R. M., San. Engr., Striger Utility Service Corp., U.S. Highway No. 45 South, Tupelo, Miss. (Oct. '45) *P*

LOSSES

Deaths

Croft, Harry P., 208 Maple Ave., Trenton 8, N.J. (Jan. '24) *PR*

Jones, Myron T., 1825 Coventry Rd., Columbus 12, Ohio (July '42)

Mayer, Edward B., Exec. Engr., Dept. of Water & Power, Box 3669 Terminal Annex, Los Angeles 54, Calif. (Oct. '29) *M*

Monroe, Owen, Vice-Pres. & Treas., Heldt-Monroe Co., 217 S. Bedford Ave., Evansville 9, Ind. (Oct. '42) *PR*

Resignations

Biggs & Co., J. E. Biggs, Pres., 1401-03 Lamar St., Box 179, Wichita Falls, Tex. (Assoc. M. Apr. '50)

Campbell, Gordon, Sales Engr., Gorman's, Ltd., 10238—104th St., Edmonton, Alta. (July '50)

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Carlton Water Dept., Clarke Morton, Water Supt., Carlton, Ore. (Corp. M. Apr. '50) *M*

Humphrey, N. Allen, Sales Engr., Johns-Manville Corp., 917 State Planters Bank Bldg., Richmond, Va. (Oct. '46)

Osberg, Alfred T., Supt.-Gen. Mgr., King County Water Dist. No. 20, 1822 S. 120th St., Seattle 88, Wash. (Apr. '44) *M*

CHANGES IN ADDRESS

Changes received between April 5 and May 5, 1951

Albrecht, Robert H., Eng. Dept., E. I. du Pont de Nemours & Co., Wilmington, Del. (Jan. '39) *MP*

Anderson, H. Kenneth, Hydr. Engr., Bureau of Water Works, 209 City Hall, Portland 4, Ore. (Oct. '50)

Badgeley, George W., Asst. Distr. Supt., Long Island Water Corp., 733 Sunrise Highway, Lynbrook, N.Y. (Apr. '49) *M*

Bankson, E. Edwin, 401 Argonne Dr., New Kensington, Pa. (Oct. '50)

Barnard & Burk, Cons. Engrs., Jack S. Burk, Partner, 314 Triad Bldg., Baton Rouge 6, La. (Corp. M. Jan. '48)

Bartlett, Terrell, The Terrell Bartlett Engrs., 232 Bedell Bldg., 118 Broadway, San Antonio 5, Tex. (June '23) *PR*

Behlmer, Harold H., Supt., Water Dept., 1308–5th St., S., Fargo, N.D. (Jan. '44) *MP*

Berdell, Charles P., Gen. Chem. Div., Allied Chem. & Dye Corp., 25 Broad St., New York, N.Y. (Oct. '47) *P*

Beymer, William, *see* Carmel (Ind.) Water Dept.

Carmel Water Dept., William Beymer, Supt., Carmel, Ind. (Corp. M. Jan. '51) *MR*

Cecil, Lawrence Keith, Gen. Sales Mgr., Infilco, Inc., Box 5033, Tucson, Ariz. (Jan. '28) *PR*

Churchill, C. F., *see* Wilmington (N.C.) Water & Sewerage Dept.

Cole, Thomas A., Bacteriologist, 26 Fountain Pl., Poughkeepsie, N.Y. (Jan. '35) *P*

Condon, J. A., *see* Inertol Co., Inc.

Cordle, Thomas Llewellin, Cons. Engr., 105 Edgewood Ave., Morgantown, N.C. (Jan. '43) *MP*

Craig, Stanley R., 801 Emerson Ave., South Bend, Ind. (July '46) *MP*

Crandell, James H., Chief Pump Operator, Corps of Engrs., 5900 MacArthur Blvd., Washington, D.C. (Oct. '49) *P*

Davis, Jack, Mgr., American Casting Service, 6455 S. California Ave., Chicago 29, Ill. (Apr. '43)

Davis, Jack W., Dist. Mgr., Transite Pipe, Johns-Manville Sales Corp., 526 Continental Oil Bldg., Denver 2, Colo. (Jan. '49)

Devinney, Robert J., Manhattan Borough Engr., Dept. Water Supply, Gas & Elec., Municipal Bldg., New York, N.Y. (Jan. '48)

Dundas, N. F., 5550 Alhambra Ave., Los Angeles 32, Calif. (Oct. '46)

Gallaher, Hugh M., Gen. Mgr. & Chief Engr., Coachella Valley County Water Dist., Coachella, Calif. (Oct. '50)

Gibeau, H. A., Director of Public Works, 275 Notre-Dame St., E., Montreal, Que. (Apr. '45) *MP*

Gibney, William J., Pres., Gibney-Coffman Corp., 17 Lincoln Rd., Buffalo 21, N.Y. (Oct. '49)

Glendale Public Service Dept., L. W. Grayson, Gen. Mgr. & Chief Engr., 119 N. Glendale Ave., Glendale 6, Calif. (Corp. M. Dec. '14) *MPR*

Grantham, George R., 1036 S. 31st St., Apt. 15, Omaha, Neb. (Jan. '44) *PR*

Grayson, L. W., *see* Glendale (Calif.) Public Service Dept.

Greco, A. J., New Jersey Div. Mgr., American Water Works Service Co., 1 Morgan Ave., Palmyra, N.J. (Jan. '39) *M*

Greene, William J., Jr., Wiedeman & Singleton, Engrs., 239 E. Wesley Rd., N.E., Atlanta, Ga. (Oct. '46) *P*

Grossman, Irving, c/o Dist. Health Office, 510 Terminal Bldg., Rochester, N.Y. (Apr. '50) *PR*

Hagberg, Ralph A., Industrial Chem. Sales Div., West Virginia Pulp & Paper Co., 2775 E. 132nd St., Cleveland 20, Ohio (July '46) *P*

(*Continued on page 40*)


HERSEY
Hersey builds a good meter for every kind of water service. Accuracy, Dependability and Low Maintenance Costs are outstanding features that sixty-five years of experience has put into every Hersey Water Meter.
HERSEY MANUFACTURING COMPANY
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BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — SAN FRANCISCO — PHILADELPHIA — LOS ANGELES — ATLANTA — DALLAS — CHICAGO

(*Continued from page 38*)

Hammer, Ole J., Secy. & Mgr., Glendora Irrigation Co., 224 N. Michigan, Glendora, Calif. (Oct. '50)

Hatfield, Lawrence G., W. H. & L. D. Betz, 223 W. Jackson Blvd., Chicago 6, Ill. (Jan. '45) *P*

Hawley, John J., Sales Service, Hersey Mfg. Co., 4405 S. Calhoun St., Fort Wayne 6, Ind. (Apr. '43)

Hennigan, Robert D., Asst. Dist. San. Engr., State Dept. of Health, Foote Bldg., Syracuse, N.Y. (Oct. '49) *P*

Inertol Co., Inc., J. A. Condon, 480 Frelinghuysen Ave., Newark 5, N.J. (Assoc. M. Oct. '44)

Jones, Fred D., Distr. Supervisor, 305 City Hall, Spokane, Wash. (Jan. '38)

Kazmann, Raphael G., Cons. Ground Water Engr., 419 W. 7th St., Stuttgard, Ark. (Apr. '46)

Kelly, R. A., Supt., City Utilities Com., Corbin, Ky. (Apr. '49)

Kennedy, A. J., *see* Riverside (Calif.) Water Dept.

Keyes, Harmon E., Infilco, Inc., 2120 E. Silver St., Tucson, Ariz. (July '47) *P*

King, Richard, Assoc. Prof., Civ. Eng., Georgia Inst. of Technology, Atlanta, Ga. (Apr. '48) *PR*

Klaer, Fred H., Jr., Ranney Method Water Supplies, Box 277 Bexley Station, Columbus 9, Ohio (Oct. '43) *R*

La Conga, Jack F., Civ. Engr., L-3 Eng. Section, Hq. Japan Logistical Command, APO 343, c/o Postmaster, San Francisco, Calif. (July '49) *PR*

Lancaster, Henry Hamilton, Water Plant Operator, 513 Powell St., San Angelo, Tex. (Oct. '49) *P*

Lauter, Carl J., 6955–33rd St., N.W., Washington 15, D.C. (Apr. '22) *Fuller Award '42. Director '45–'48.* *P*

Lund, Armon, Supt. of Public Works, Village Hall, Wilmette, Ill. (Jan. '41) *MP*

McClintock, John Harper, Route 1, Baytown, Tex. (Oct. '46) *PR*

Morin, A., 407 Melancon, St. Jerome, Que. (Apr. '45) *MPR*

Moye, Malcolm A., Jr., Box 929 Millville Station, Panama City, Fla. (Oct. '49) *P*

Pang, A. K., 750 McCully St., Honolulu 14, Hawaii (Jan. '50)

Picton, Walter L., 4820 Montgomery Lane, Bethesda, Md. (Apr. '43) *PR*

Riddle, Rolean Bill, City Mgr., Paris, Tex. (Apr. '49)

Riverside Water Dept., A. J. Kennedy, Gen. Mgr. & Chief Engr., Box 826, Riverside, Calif. (Corp. M. July '26) *MR*

Roberts, E. Fred, Dineen, Philips & Roberts, Box 605, Brantford, Ont. (Jan. '38) *MPR*

Rogers, T. M., Supt., Public Utilities, Easley, S.C. (July '35) *MP*

Salomon, L. A., & Bro., Herman Salomon, 216 Pearl St., New York 38, N.Y. (Assoc. M. Oct. '34)

Sepede, Frank J., Gen. Mgr., Water Board, North Miami Beach, Fla. (Apr. '49) *M*

Shields, Lewis S., Jr., San. Engr., State Board of Health, Box 210, Jacksonville 1, Fla. (Apr. '50)

Snidow, Herman W., Regional Engr., State Dept. of Health, Richmond, Va. (June '26)

Stearns, Donald E., R.F.D. 1, Erieville, N.Y. (July '45) *MR*

Stevens, Charles S., Hydr. & San. Engr., Lockwood & Andrews, Union National Bank Bldg., Houston, Tex. (July '48)

Truman, Chester A., 11215 S.E. Boise, Portland 66, Ore. (Dec. '26) *Director '37–'40. Fuller Award '45.*

Von Rader, John, Jr., Supt., Indio Water Service, 82–835 Bliss Ave., Indio, Calif. (Oct. '45) *M*

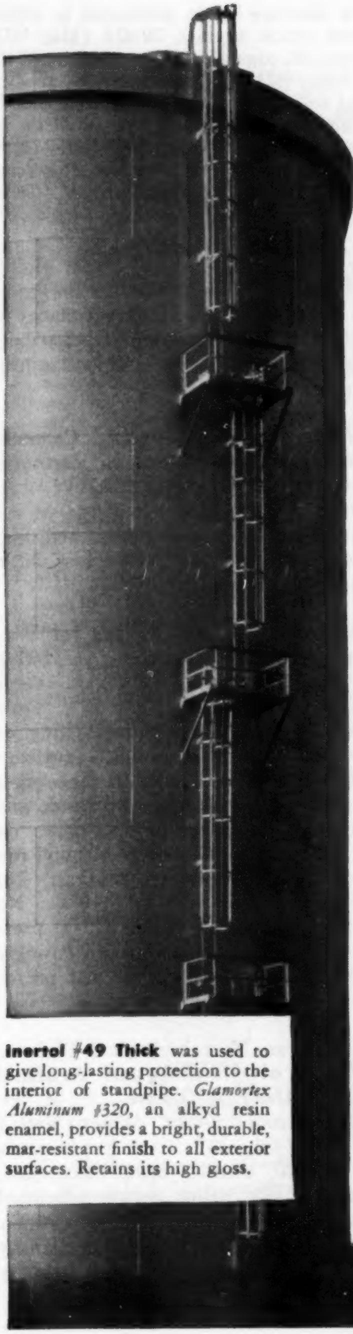
Wagner, Fred, Sales Engr., Associated Engrs., 3606 El Camino Real, Palo Alto, Calif. (Oct. '50)

Wilberding, M. X., Pres. & Engr. in Charge, Mountain State Water Co., of West Virginia, 1822 Eye St., N.W., Washington 6, D.C. (June '30) *M*

Williams, Charles Harvey, City Engr., 826 Percival St., Olympia, Wash. (July '34) *MPR*

Wilmington Water & Sewerage Dept., C. F. Churchill, Supt., Wilmington, N.C. (Corp. M. July '45) *MR*

Wood, Frank B., 230 Colonial Homes Dr., N.W., Atlanta, Ga. (Oct. '42) *P*



Condensation

Key: In the reference to the publication in which the abstracted article appears, 39:473 (May '47) indicates volume 39, page 473, issue dated May 1947. If the publication is paged by the issue, 39:5:1 (May '47) indicates volume 39, number 5, page 1, issue dated May 1947. Abbreviations following an abstract indicate that it was taken, by permission, from one of the following periodicals: *B.H.—Bulletin of Hygiene (Great Britain); C.A.—Chemical Abstracts; Corr.—Corrosion; I.M.—Institute of Metals (Great Britain); P.H.E.A.—Public Health Engineering Abstracts; S.I.W.—Sewage and Industrial Wastes; W.P.R.—Water Pollution Abstracts (Great Britain).*

DISTRIBUTION SYSTEMS

Development of Green Algae and Other Organisms in Plastic Water Pipes. A. van der Werff. Water (Neth.) **35**:4 ('51). Studies with various sizes of plastic pipes in municipal water supply service led to the following tentative conclusions: [1] The transparent pipes may cause distribution of light optimum for algae growth; [2] If algae or spores are present in the water, development may take place, especially with low velocities and effective light; [3] If plastic pipes are to be used for distribution, the drinking water must be free of algae and spores, particularly *Chlorella*; [4] The pipes investigated do not have the sterilizing action of metal piping, but, on the contrary, the sol. org. materials in low diln. may stimulate growth, while the pipe material can form a substratum for the organisms.—*W. Rudolfs.*

Concerning the Solvent Action of Water in Copper Pipes. Franz Lieb. Gas, Wasser, Warme **4**:212 (Sept. '50). The solvent action of water on copper pipes, 343.4 sq.cm. exposed, was studied with waters of the following characteristics: [1] acid, very soft and high O_2 content; [2] weakly alk., medium hard and high O_2 content, and [3] weakly alk., hard and high O_2 content. Copper, after 18 hours, varied from a min. of 2.3 ppm. in the hard water to 6.4 ppm. in the soft water. The solvent effect on the copper is due to oxidation, not acid action. Copper in a water standing overnight in 17-year-old copper piping distributing system showed 0.2 ppm. to 0.1 ppm. at three different places in the line. Copper piping for distributing systems is more desirable than lead piping.—*P. K. Mueller.*

Water Samples From Cement-Asbestos Pipe Systems in Vermont. Edward L. Tracy. J.N.E.W.W.A. **64**:164 ('50). During a period of apparent stabilization, hardness and total alky. increase. Afterward very little change occurs.—*C.A.*

Studies on "Plastic" Pipes for Water Transport. Institute for Testing Water Equipment [KIWA]. Water (Neth.) **34**:195 (Sept. 14, '50). Tests with "polysanite" pipes consisting of polyvinylchloride with 5% softener and 2% stabilizer added. The pipes are brown in color, smooth inside and outside. Some bending of pipes on storage, become soft about 60° and run above 70°C., allowing joining. No effect of temperature to − 10°C. No fatigue phenomena after 31,000 pressure tests; no corrosion with strongly aggressive water; rats do not prefer it to lead.—*Willem Rudolfs.*

Studies on Microbiological Disintegration of Natural and Artificial Fibers Used as Twine. C. A. H. von Wolzogen Kuhr. Water (Neth.) **34**:154 (July 20, '50). Experiments with sisal, manila, hemp, flax, jute, artificial silk, nylon, perlon submitted to aerobic and anaerobic conditions. Using Beyerinck and Omeliansky media, the natural fibers were strongly

(*Continued on page 44*)

(Continued from page 42)

attacked after 2–3 years and the artificial fibers in 3 months to $2\frac{1}{2}$ years. The latter more susceptible to aerobic decomposition than to anaerobic deterioration.—*Willem Rudolfs.*

Economical Utilization of Pipes. RUDOLF LUDD. Wtr. & Wtr. Eng. (Gt. Br.) **52**:551 (Nov. '49). Economic discharge of pipeline can be found by fulfilling condition that combined cost of amortization and pumping for one cu.ft. of water becomes min. Economical discharge is:

$$Q_0 = \sqrt[3]{\frac{A}{2c\beta k}}$$

Total cost is

$$\beta_1 k_1 + \beta_2 k_2 \left(\frac{Q_1}{Q_0}\right)^3 + \ . \ . \ . \ \beta_r k_r \left(\frac{Q_{r-1}}{Q_0}\right)^3$$

Unit cost of whole pipe is

$$\alpha_1 k_1 + \alpha_2 k_2 \left(\frac{Q_1}{Q_0}\right)^2 + \ . \ . \ . \ A_r k_r \left(\frac{Q_{r-1}}{Q_0}\right)^2$$

in which A is annual interest and amortization cost of pipeline; d is diam. of pipe; c is const. such that pumping cost is cQH; H is loss of head in ft.; k is total unit loss in pipeline, equal to $k_1 + k_2 + \ . \ . \ . \ k_r$; k_1, k_2, . . . k_r, respectively, represent loss in pipeline sections of length L_1, L_2, . . . L_r; k_0', k_0'', . . . k_0^r, respectively, are consts. for cross sections of pipeline. For example, k_0, computed by Manning's formula, is $\frac{2.6563 \times 10^9\, n^2}{d^{16/3}}$; L is length of section of pipeline; n is Manning's and Kutter's friction coefficient; p is such that if the discharge released from pumping plant is Q_0, and amt. equal to pQ_0 is uniformly delivered along the pipeline; p_1 is $\frac{Q_0 - Q_1}{Q_0}$, p_2 is $\frac{Q_1 - Q_2}{Q_1}$, etc.; Q is discharge in c.f.s.; Q_1, Q_2, . . . Q_r are

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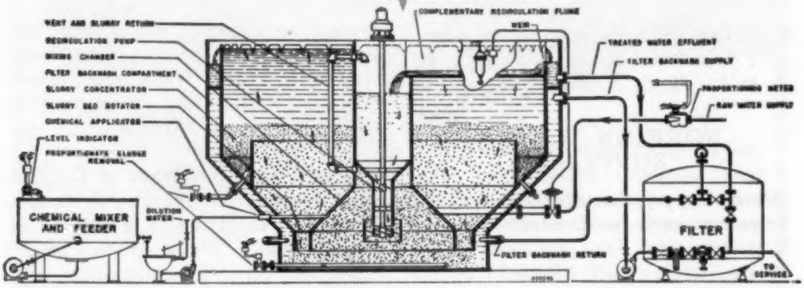
UNIFORM TREATMENT UNDER VARIABLE LOAD CONDITIONS



THE WORTHINGTON SLURRY BED WATER SOFTENER AND COAGULATOR, TYPE CM — AN IMPORTANT DEVELOPMENT IN THE FIELD OF MUNICIPAL WATER TREATMENT

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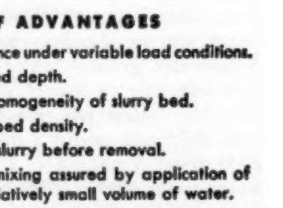
- **Maintenance of homogeneity of slurry bed.**
- **Control of slurry bed density.**
- **Full utilization of slurry before removal.**
- **Quick, thorough mixing assured by application of chemicals to a relatively small volume of water.**
- **When filters are used in softening, an adequate supply of clear treated water backwashes the filters — independent of the softening process and without loss of water.**
- **Symmetry of reaction tank design.**
- **Full retention time always maintained, because there is no deposit build-up in the bottom of the reaction tank.**
- **Can be furnished with dry chemical feeders and gravity filters.**
- **Internals of reaction tank adaptable to concrete tank construction.**

JO. 4

WORTHINGTON

WATER CONDITIONING



Worthington Makes More of the Equipment for All Types of Water Conditioning Systems

(*Continued from page 44*)

discharge, respectively, at ends of respective sections $L_1, L_2, \ldots L_r$; r is total number of sections in pipeline; $\alpha_1, \alpha_2, \ldots \alpha_r$ are functions, respectively, of $p_1, p_2, \ldots p_r$ in which α_1 is $1 - p_1 + \frac{p_1^2}{3}$; $\beta_1, \beta_2, \ldots \beta_r$ are functions, respectively, of $p_1, p_2, \ldots p_r$ in which β_1 is $1 - 3/2p_1 + p_1^2 - p^3/4$.—*H. E. Babbitt.*

FOREIGN WATER SUPPLIES

Water Supply, Sewage Disposal and Improvements for Greater Warsaw. Włodziemierz Skoraszewski. Gaz, Woda i Tech. Sanit. (Poland) **24**:311 (Sept. '50). Vistula R. is source of water supply as well as outlet for sewage from Warsaw. With increased industrialization and mining activities in upper reaches of Vistula R. the water qual. will deteriorate and may prove unsatisfactory for domestic use. Other sources of water must be found. Apparently ground water sources in area adequate to supply increased future pop. (1951 pop. about 1 million, estd. 1975 pop. about 3 million, in yr. 2000 about 5 million). Present daily water usage about 40 gpcd.; estd. future requirement about 45 gpcd. It is estd. that 90% of pop. will be connected to distr. system by year 2000. Study of water resources urged during next 6 yr. and plans should be made toward realizing the needs of greater Warsaw during the next 50 yr.—*C. P. Straub.*

Water in the Amazon Region. Harald Sioli. Forschungen u. Fortschr. **26**:274 ('50). Waters from the Tertiary region of the lower Amazon are among the chemically purest in the world. They contain no phosphate, sulfate, Al or Mn and are low in Cl (0–3 ppm.), Ca and Mg (0–5 ppm.), Fe (0–0.5 ppm.), and bicarbonate (0–7 ppm.). The free CO_2 is high and the pH is between 4.5 and 5. North and south of the lower Amazon the water has a higher mineral content and a higher pH. Al is not present in water in the Amazon region as the low concn. of cations prevents ion exchange with Al in the soil. SiO_2 is present in amounts comparable with that found in European or North American waters. Geol., agricultural and biol. factors are correlated with the compn. of the water.—*C.A.*

Water Supply by Means of Condensate Water from the Royal Netherlands Salt Industry at Hengelo. M. van Daalen. Water (Neth.) **35**:271 (Dec. '21, '50). Shortage of the city's water supply augmented by an initial 265,000 gpd., which after a year may increase three times: sufficient until 1970. The condensate from the triple distilled brine may contain some chlorides. The concns. of chlorides are controlled by a chloride indicator which cuts off the flow to the distr. system. The water is very soft; hardness 4–7 ppm., no iron, chlorides 175–1400 ppm., no CO_2, temp. 40–50°C. Effluent is water cooled by condensers fed by canal water at a rate of 620 tons/hr. producing a water temp. of about 30–35°C., followed by cascading and mixing with well water to 17.5–20°C.—*W. Rudolfs.*

Mountain Water Catchment. J. Frois. Tech. Munic. Sanit. **45**:234 (Dec. '50). The city of Bayonne, France, solved its water supply problem by using two types of catchments in nearby mountains. First type collects infiltrating waters in shallow wells dug in primary rock formations, yielding water of very good qual. Large no. (110) of wells, however, produces difficulties of maint. and detn. of source of bact. contamn. in epidemics. Water has 30 ppm. total hardness; total output: low summer flow: 2,500 cu.m. per 24 hr. for the

(*Continued on page 48*)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PEKRUL MODEL 56 GATES with Philadelphia Limitorque Model M30 Motorized Lifts in operation at Denver Sewage Disposal Plant.
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(*Continued from page 46*)

100 wells now in use. Second method is direct catchment of infiltrations through primary sandstone and sandstone schists, at their point of emergence in bed of a small mountain stream. The catchment is at the side of an artificial bed provided for the stream to avoid eventual poln. of the supply caused by infiltration or fracture of pipes by rocks in spring thaws. Water has total hardness of 95 ppm.; *E. coli* 25/100 ml. Prechlorination practised at the catchment with 0.1 ppm. Cl_2.—*Marc S. Albanese.*

The Water Supply of the City of Houtabon [France]. M. BONHOMME. L'Eau **37**:101, 113 (Jul.–Aug. '50). After wells and infiltration galleries failed to produce sufficient quantities, water treated from Tarn R. Consumption 0.24 mgd. Treatment by coagulation, accelerated flocculation (keeping floc formed in suspension and mixing with raw water and coagulants), filtration and chloramine.—*W. Rudolfs.*

The Water Supply of Madras City, India. ANON. Wtr. & Wtr. Eng. (Br.) **54**:110 (Sept. '50). Water supply is drawn from Red Hills Lake through intake tower known as "Jones Tower." Water passes through masonry tunnel, enters screening chamber and roughing filters at Red Hills, and flows by gravity through two masonry arched underground conduits 7½ mi. long and enters Kilpaik Water Works where it is filtered, chlorinated and pumped to distr. All works were carried out and are maint. by Corp. of Madras. Red Hills Lake is situated about 8 mi. northwest of Madras.

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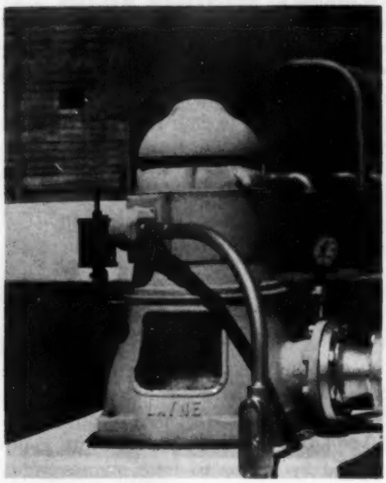

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Total quantity of water from lake for city supply in normal yr. will be about 8,750 mil.gal. (Imp.) and for irrigation will be about 340 million cu.ft. To meet increased demand for water it was decided in '40 to dam Kortalayar R. and form reservoir at Poondi. This is designed to impound 2,500 million cu.ft. Reservoir located 37 mi. northwest of Madras, completed in June '44; renamed "Satyamurthi Sagar." Until '14 water from Red Hills Lake was drawn through open channel to Kilpauk and drained into distr. without filtration or pumping. Since open channel subject to poln. covered masonry conduit was constructed. Flow is gravitational with avg. gradient of 1:4470. Two villages en route are supplied by means of hand pumps fixed at manholes in conduit. Second masonry conduit was constructed in '49, with capacity of 32 mgd. (Imp.).

At Kilpauk there are 17 slow sand filters, 14 measuring 100 × 200 ft. and three 130 × 200 ft. Water is chlorinated before filtration. Avg. filtration rate is about 8 vertical in. per hr. Filtered water storage capacity is 6.5 mil.gal. (Imp.). Water gravitates to pump suction. It is pumped to distr. through 48-in. steel main about ½ mi. long. Steel circular elevated tank, 104 ft. in diam. with capacity of 1½ mil.gal. (Imp.) acts as balancing tank. There are 3 steam and 2 electrical pumps with combined capacity of 56,000 gpm. (Imp.) against total head of 80 ft. Distribution system consists of 29.5 mi. of trunk mains from 9 in. to 48 in. in dia. and nearly 365 mi. of distr. pipes varying in size from 4 in. to 8 in., with some 2½ and 3-in. pipes. Three automatic electric booster pumps were installed in '34. These operate from 6.30 to 10 A.M., and 4 to 6 P.M. daily. They cause defects in adjacent areas by suction effect. Fault was guarded against when similar pumps were installed for 3 other defective areas, where water is drawn at night by gravity into underground storage tanks of 300,000 gal. (Imp.) from which pumps draw water mornings and evenings. Water supplied from Red Hills Lake averages 20 mgd. (Imp.), or about 30 gpcd. (Imp.) per day. 54,000 private house connections are on the Red Hills Supply. Plumbing inside houses is done by licensed plumbers. Ordinarily two taps with ¾″ service pipe are allowed without meter for domestic houses. There were about 2,670 fire hydrants, 3,595 public fountains, 182 bathing fountains, and 64 cattle troughs as of March 31, '49. Full-time water analyst at Kilpauk supervises chlorination of water. Water tax at 1½% of annual revenue of premises is levied for maint., giving income of Rs. 700,000, with additional Rs. 1,150,000 from metered connections, supervision

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charges on work of private house connections, etc. Construction of second conduit from Red Hills to Kilpauk has been completed. It is similar to first conduit, rectangular in cross section, 6′6″ wide, 4′ high to springing of arched roof which has height of 2′6″. Total length is 39,485′. Flow is gravitational with capacity of 32 mgd. (Imp.). Manholes have been provided at min. intervals of 1,000′. Distr. system in South Madras is found defective. Separate 48-in. trunk main is under execution to remedy defect. Scheme for third electric pumping unit at Kilpauk, with capacity of 1.2 mil.gal./hr. (Imp.) was sanctioned in '46. Estimates for laying duplicate 48″ main for length of 3,000′ from Kilpauk Pumping Sta. to Kilpauk Shaft was sanctioned in '49. Preliminary scheme for installation of rapid mechanical filters with capacity of 40 mgd. (Imp.) was sanctioned in '48. If Krishna-Penna Scheme, now under consideration mainly as irrigation project, materializes, it will be possible to replenish supply at Satyamurthi Sagar and place city supply on sound basis.—*H. E. Babbitt.*

Augmentation of Melbourne's Water Supply. H. BOWDEN FLETCHER. Wtr. & Wtr. Eng. (Br.) **54**:101 (Sept. 50). In '42 capacity of existing storage reservoirs was 23,351 mil.gal. (Imp.) and per capita consumption been steadily rising. In '48–'49 consumption averaged 93.92 mgd. (Imp.). In '39 board had decided to develop Upper Yarra catchment area by constructing reservoir with capacity of 30,000 mil.gal (Imp.). Cost of scheme at that time estd. at £3,000,000. New est. for work today is £7,800,000. Existing storages, in mil.gal. (Imp.) are: Yan Yean, 6,605; Toorourrong, 60; Maroondah, 4,855; O'Shannassy, 930; Silvan No. 1, 8,823. Present program of develop-

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ment in Upper Yarra comprise: [1] Rolled-earth and rock-filled dam 260′ high; crest 1,900′ long and 40′ wide at top; max. base width of wall 1,500′; and area of water surface 1,600 acres, backing water up 6¼ miles along Yarra and 5¼ miles along Walsh's Creek. [2] Two 68″ pipelines 23 miles long to convey water at 150 mgd. (Imp.) to Silvan No. 1, Reservoir. [3] Driving two tunnels on conduit line, 6,200′ and 1,000′ long, respect., each having internal size 9′6″ high by 9′ wide in horseshoe shape. [4] Construction of township at site of dam to house 500 men and families, together with essential stores and administrative buildings. Work has commenced on stripping site of dam and on 2,600′ diversion tunnel to take Yarra R. water away from working area. Concrete lining of Little Joe tunnel is to be finished in Sept. '50. Lining is in three sections requiring: full reinforcement, 50% reinforcement, and no reinforcement. First involves 8 tons per 100 ft. 300 ft. of tunnel is handled in each two weeks.—*H. E. Babbitt.*

Golden Jubilee of The High Wycombe Corp. Water Undertaking. Anon. Wtr. & Wtr. Eng. (Br.) **54**: 187 (Nov. '50). Earliest mention of piped water supply in High Wycombe is in middle of last century when a few propertyowners were supplied with water by Wheeler Brewery. High Wycombe Water Works, Baths and Wash-houses Co. was formed in '70 and in '74 original High Wycombe Water Order was obtained. In '75 129,000 gal. (Imp.) reservoir was constructed and another of 130,000 gal.

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was constructed in 1897. In '22 it was found necessary to replace pumping plant which had been installed in '01. In '32 large program of work was started consisting of 42" well, another pumping station, well pump with capacity of 4.8 mgd. (Imp.) and duplicate 100,000 gph. low-level pumping sets. Consumption increased enormously during war years. In '45 it reached 848 mil.gal. (Imp.). In '47 additional pumping unit was installed with capacity of 50,000 gph. (Imp.). Charges to consumers are very low. Rate paid today is generally less than in '25.—*H. E. Babbitt.*

SOURCES OF SUPPLY

Spanish Practice of Mountain Water Catchments. M. Paz Maroto. Tech. Sanit. Munic. (Fr.) **45**:245 (Nov.–Dec. '50). After exposing the unfavorable hydrological conditions of Spain and their effect on mountain water supplies various types of Spanish mountain water catchments are discussed: Springs, caught in wells covered by small buildings with a settling chamber for sand, or in covered canals and aqueducts. The yield rarely exceeds 700 l./sec. and usually much lower (not over 100 l./sec.). Catchments are always practiced below ground surface. Water table-level wells have impervious walls and pervious bottom, of brick or masonry. For important catchments, galleries 60 × 80 cm. are used, with inspection manholes. Deep underground streams occur sometimes under impervious deep terrain, itself sustaining a water table on its surface. "Combination wells" are used, reaching under the impervious level and also collecting the waters over this level; galleries are used jointly if the "stream" is important with the side against the flow pervious, the opposite side impervious. Surface waters: More and more used, the only way to provide 150 to 200

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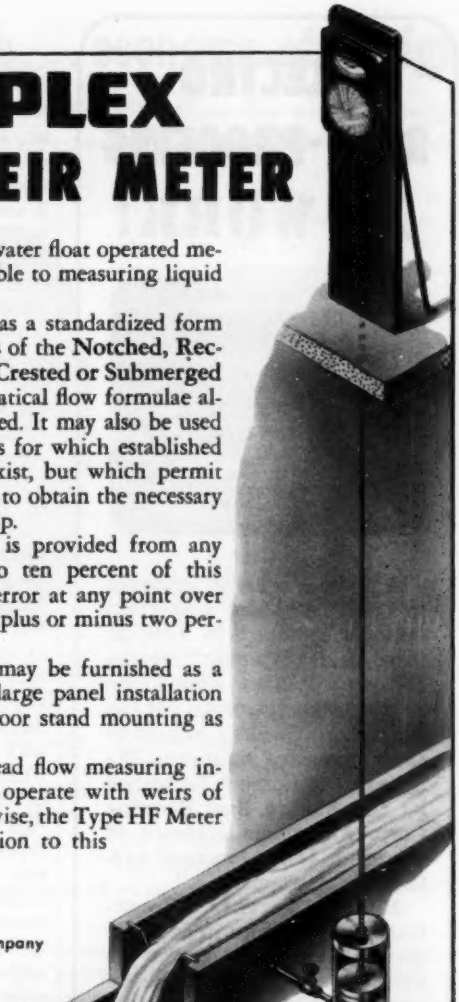

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l./cap./day, as required by Spanish law in all seasons. Construction of dams of the gravity/straight type, with or without buttresses, with central overflow and one or more adduction mains, of capacities ranging between 2 and 14 million cu.m. (70.7 million to 495 million, cu.ft.), seem best suited for groups of mountain and even lowland communities of 5,000 to 100,000 with larger dams for larger cities such as Madrid (water consumption 400,000 cu.m. daily day and reservoir capacity of 75 million cu.m. but will soon need 125 million cu.m.) (2.275 and 3.970 million cu.ft.). A comprehensive survey of the present water supplies in Spain is also given.—*W. Rudolfs.*

Catchment of Springs in the Limousin (France). M. Martel. Tech. Sanit. Munic. **45**: 238 (Nov.–Dec. '50). Present methods surveyed of catching spring waters in primary rock formations of the Limousin for water supply of local small and medium-sized rural communities. Four rock substrata usually encountered with springs in: [1] Granulite (granite contg. white mica), hard but creviced and decomposed on surface. 3 types of springs: slope, circus. at origin of valley, thalweg springs. [2] Granite, similar to granulite, with more detritic tuff. Same types of springs, but the thalwegs in shallow and flat valleys. [3] Mica schists (quartz and mica) creviced and decomposed on surface up to 12′. 2 types of springs: slope and circus. at head of valley. [4] Gneiss, with up to 42′ detritic tuff on top. One type of spring: origin of valley. Slope waters are best, thalweg waters more abundant but less reliable in quality. These types of springs are evaluated and collected as follows: an exploratory trench is dug along the line of maximum incline, parallel to the water emergences and down to the bottom

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rock to evaluate the best point of collection at rock level; then one or more drainage trenches are dug above the points of emergence at the most favorable location determined by the exploratory trench, along a level curve, with an inclination of 1% on the horizontal and down 0.40 m. in the bottom rock. When topsoil and detritic rock exceed 21′ dept, galleries are used instead of trenches, renewed from the Roman practice in this region. The drainage trench is built into an aqueduct of concrete vertical walls, 20 × 30 cm. and 30 cm. apart, resting on a concrete foundation 20 cm. thick; covered by a reinforced concrete slab 15 cm. thick with 2% slope; the wall against the water flow has openings and a layer of coarse stones plus gravel to facilitate water collection. The water is collected in a clear well 1 cu.m. capacity. When galleries are used, the inside dimensions are 0.9 × 1.8 m. with masonry covering and same layout as for aqueducts; galleries prove more durable than aqueducts, especially against corrosion. Average yield of the various catchments: from 2 to 20 l./sec.—*W. Rudolfs.*

Water Catchments in Volcanic Terrain. H. Patrix. Tech. Sanit. Munic. (Fr.) **45**:243 (Nov.–Dec. '50). Study of water catchment methods as practiced in the volcanic regions of central France. Two main kinds of volcanic formations are considered: [1] Tertiary (ancient) formations: fragment of lava streams, greatly fissured and superficially decomposed. Rich in water supplies, these rocks provide springs with capacity of 5–10 l./sec. at the level of impervious substrate, springs are collected by drainage trenches. [2] Quaternary (recent) formations, usually divided in 2 groups: projections (ashes, pouzzolanes) which are great collectors, condensers and filterers of water; and

(*Continued on page 62*)

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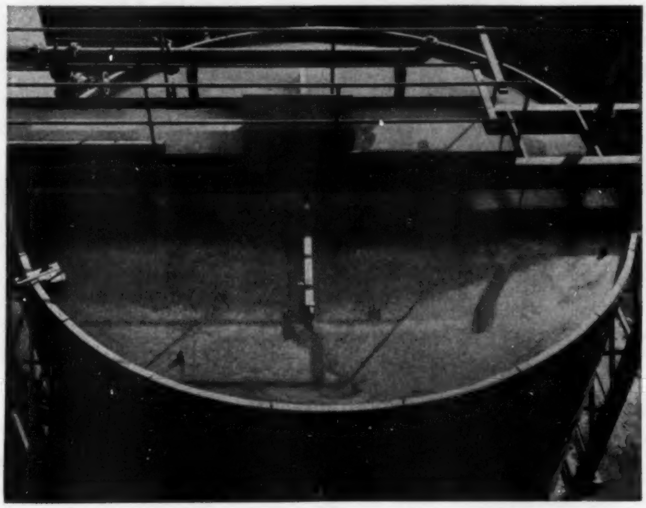
lava streams, covering subjacent rock or projections, at the end of which water emerges (50–100 l./sec.) quite localized; some side emergences are sometimes found, with variable yield. Catchments are practiced on lava streams at the level of a constriction in the stream (best chances of encountering main stream of water, at least expense) and above the point of emergence (to avoid poln. by neighboring communities). Since there are usually several levels of impervious material (non-fissured lava) in the lava stream, it pays to use one of these as the water-bearing stratum level instead of the nonvolcanic subjacent rock because the water at this low level is used at the point of emergence by surrounding residents. Exploratory drillings and magnetic and electric projection are necessary to locate the best point of catchment, then a gallery (from down- to up-slope) is dug; streams are found underground with an output of 80–200 l./sec., of excellent water; however, the output can decrease as much as 40% in 25 years, unless underground damming of such water is practiced, which appears, theoretically, the best way to regularize and maintain water yield in such terrains.—*W. Rudolfs.*

Supersonic Methods Short-Cut Reservoir Silt Measurements. C. W. Thomas. Civ. Eng. **19**:323 ('49). The author discusses the importance of detg. the distribution of sediment in reservoirs and describes conventional methods of surveying and various types of supersonic echo-sounding equipment suitable for measuring the amount of silting.—*W.P.A.*



WOOD REACTOR TO COAGULATE RIVER WATER IN NEW JERSEY FOR PRETREATMENT AHEAD OF ZEOLITE PLANT FOR BOILER FEED. CAPACITY—860,000 GPD.

(Continued from page 22)

"Dowsing Is Nonsense!" So says A.W.W.A. member, consulting engineer and chemist Tom Riddick in a feature article to appear in the July issue of *Harper's Magazine*. And in so saying, temararious Tom takes a tiger by the tail, for he clearly labels his language a response to Kenneth Roberts' best-selling *Henry Gross and His Dowsing Rod*. But hold that tiger, Tom, we're with you now to the better end.

Our own review of *Henry* (March P&R p. 1) and later comments (April P&R p. 1) were safe enough until David Dempsey of the New York *Times* book review section got hold of them and reprinted a few juicy quotes in his Sunday column. That brought publisher Doubleday's curious publicity manager up to the A.W.W.A. office pronto. And that, in turn, led to the dispatch of the above issues of the JOURNAL to Ken in Kennebunkport, Me. By now, of course, our nerves are twitching like a twig over a water "dome."

Dame Nature is being taken advantage of again, this time by another dame—one Dr. Maria Telkes of Massachusetts Institute of Technology, who has added insulation to ingenuity in devising a solar still which will not leak off half the sun's energy into the ground. Reporting to the American Chemical Society, Dr. Telkes, who previously gained fame in harnessing the sun to her solar house at Dover, Mass., indicated that her new solar system, which is almost 100 per cent more efficient than the old type, can produce fresh water for about $1,200 per mil.gal. Of course, that's just production, and since production is only the beginning of their story, we sort of doubt that many municipalities are going to buy right now. Besides, we really question whether any municipality is actually interested. After all, not a single one has approached us for permission to use our fresh frozen salt water idea, and if you don't find making ice cubes and melting them a lot easier and more in your line than collecting the drippings from a glass roof, some other dame is taking advantage of you.

While the sun's out, though, we ought to take a squint at an even more timely hot water item—the "Roof Spray Canopy." Consisting of pure water sprayed in a cloud above a roof to absorb solar heat and on a roof to carry away any that gets through before it penetrates to the building beneath, the "canopy" was devised during World War II as a means of making many hastily erected one-story industrial buildings workable in during the summer. Now the system is being peddled promiscuously, not only as a cooler-offer but as a means of increasing the life of a roof by stopping its loss of volatile oils. And if we, who can well imagine one of these personal clouds anchored to every television antenna, shudder a little at the thought of being asked to make rain on everyone's roof, it's probably because we have a loose shingle somewhere. Anyway, consider the camouflage.

(Continued on page 66)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for efficient maintenance
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INVERTED PLUG CURB STOP
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OVER 80 years of manufacturing experience . . . designed for easy installation . . . long years of trouble-free service . . . interchangeable with those of other manufacturers . . . corporation stops can be installed with any standard tapping machine.
All Hays fittings made of single, uniform, high quality water service bronze, 85-5-5-5 mix . . . hydrostatically tested at 200 pounds or more . . . plugs individually ground in for perfect fit . . . specially lubricated for permanent easy turning.
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12TH & LIBERTY STREETS, ERIE, PENNA., U. S. A.

(*Continued from page 64*)

"Crazy over horses" is New York City's A.S.P.C.A. At any rate, finding it difficult to lead horses to water since the water department shut off service to the old water troughs during the 1949–50 drought, the society now leads water to such horses as still survive the city's carbon monoxide atmosphere. Sloshing around in a 500-gal. tank-truck, like an equine "Good Humor" man, an A.S.P.C.A. "special agent" makes the best watering places on an established schedule, setting up a portable trough and inviting all thirsty steeds to stop by for a quickie.

Thus having proved itself (at least to us) to be anything but "crazy," the society makes sure to demonstrate that it is not discriminatory by indicating, too, that it is a little "mad over dogs," who, if they happen by the water wagon, are set up to a short snort in a special circular fountain designed for the canine lap.

Drowning one's sorrows has always been interpreted to require a rather potent liquid medium, so the recent discovery by a University of California psychologist that water drinking can provide an escape from anxiety is by way of being revolutionary—particularly with increased taxes soon to be applied to the usual stuff of liquetherapy. Working with white rats, Dr. Irving Maltzman found that all he had to do to increase water consumption was to agitate his subjects by a slight electric shock, and that, as their emotional stability returned, water consumption also returned to normal. Any alert water works man will, of course, want to consider the possibilities of these data in terms of boosting sales or promoting conservation in his own community, but on a much larger scale we see in it an explanation of the direct correlation between the advance of civilization and the increase in per capita consumption of water. Much as we appreciate water, though, we reserve the right, when we get down to concentrated concern over the problems of the atomic age, to make our own escape more certain.

Now, though, we can *really* talk about mass medication!

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Old Indomitable is what they're now calling Ross Dobbin, general manager of the Peterborough, Ont., utilities commission and former A.W.W.A. prexy. It was en route home from the Miami meeting and "safely" in his car after "risking" flying most of the way, that Ross apparently dozed off at the wheel, dipped into a ditch and crashed into a tree. Among other injuries sustained, a slight concussion and some fractured ribs put him into the hospital, but not for long—less than two weeks later he was out in Manitoba attending the Winnipeg meeting of the Canadian Section.

"Old Indomitable" we'll agree, but "Old Bridgehead" too. And we'll bet it wasn't dozing at all, but a review of that little slam not bid at Miami that put him in the ditch and the thought of better cards that pulled him out to Manitoba.

Richard Hazen, formerly partner in the firm of Malcolm Pirnie Engineers, has opened a consulting office of his own at 110 East 42nd St. He plans to devote his practice to municipal and industrial water supply and treatment and to sewage and waste disposal. Hazen is the new chairman of the A.W.W.A. Publication Committee.

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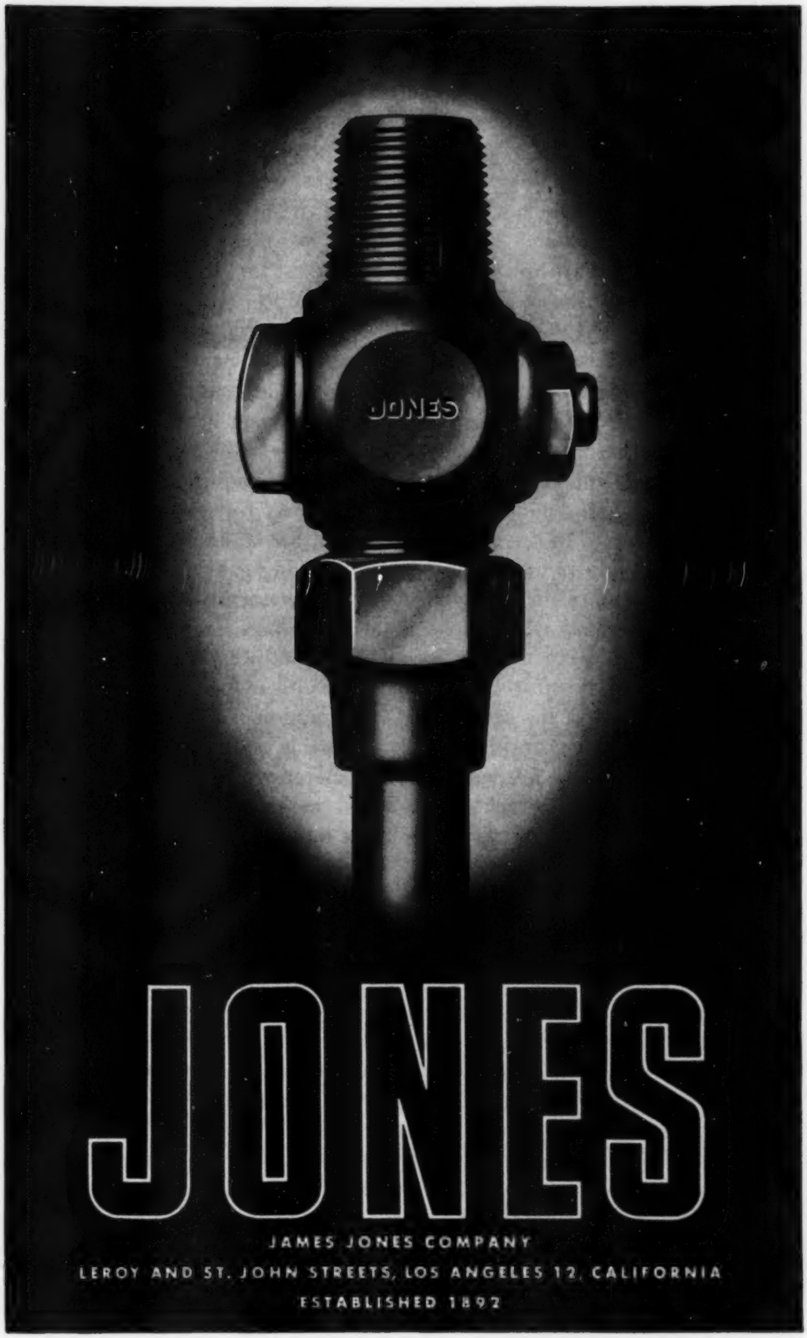
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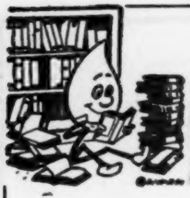
Water works—water really works! In other items in this issue we have pointed out its use as a foodstuff and a medication. In other items in other issues we have often discussed its use as a cooling agent, a beverage, a fire extinguisher, a cleansing medium, a recreation place, a solvent and a million or so other necessities. Now, however, we find it serving a brand new purpose, as a fuel—not a heating agent, as in the heat pump, but a real fuel that "burns."

Developed by two Salt Lake City inventors, the water burner can be produced to sell at about $15 for a unit adequate to heat the average home. And fuel costs would be but a small percentage of nominal as a pint of water will be sufficient to heat a four-room house for four hours. And just think of being able to eliminate the carbon deposits, oily film, smoke and other objectionable features characteristic of conventional heaters.

Although the operating details of the device are not at all public as yet, it has already been subjected to Senatorial investigation by Utah's Sen. Arthur Watkins and he hints that water is forced into the device, where it is preheated by an alcohol burner and then takes over the combustion itself, emerging in the form of jets of burning gas. We should point out that we learned of this hint and of the whole story from the *Southwest Water Works Journal*, which looks at the whole business with a somewhat jaundiced eye, presumably because of the Southwest's perpetual water shortage, but just possibly because of its wealth of oil. Anyway, it can be pointed out that at the rate of fuel consumption noted, the new burner will save more water than it uses, for flammable water certainly won't be wanted any longer as a fire extinguisher. Meanwhile, maybe some of the oil relieved of duty as a fuel will be found useful in dousing these water conflagrations. Certainly they still will not mix.

A hydraulic calculator has been developed which is based on the Hazen-Williams formula. Determinations of head loss, flow, velocity, size of pipe and the Hardy Cross factor 1.85 h/Q for differential of head loss can be made, it is claimed, accurately and rapidly with a minimum of practice. The calculator gives values for conditions not shown in the various pipe tables, and is not confined to a single C value for coefficient of roughness when dealing with pipe sizes normally found in distribution systems. The total head loss for pipes 100 to 20,000 ft. long may be found directly without determination of the slope per 1,000 ft. The range of pipe sizes covered is 4 to 72 in.; of head losses, 0.06 to 250 ft. Discharge quantities are expressed in gallons per minute and million gallons per day.

The calculator consists of two circular discs and a plastic indicator arm; its diameter is 6 in. It may be obtained at a cost of $6.00 postpaid from Robert E. Martin, 210 Heyburn Bldg., Louisville 2, Ky. Operating instructions are included.



The Reading Meter

Better Health for 5 to 14 Cents a Year Through Fluoridated Water. *Public Health Service Pub. No. 62, Div. of Dental Public Health, Public Health Service, Federal Security Agency, Washington 25, D.C. (1951) single copies free*

This 22-page mimeographed bulletin is obviously written for the lay public and definitely is aimed at promoting fluoridation. The material is complete and the reasoning is quite persuasive.

Fluoridation in the Prevention of Dental Caries. *Council on Dental Health, American Dental Assn., 222 E. Superior St., Chicago 11, Ill. (1951) single copies free*

In the foreword of this 28-page manual is the statement that:

> The fluoridation of public water supplies is now widely accepted as another method for reducing the prevalence of dental caries. Of all the preventive methods in use, including toothbrushing, restriction in the consumption of concentrated sugar and topical application of sodium fluoride, fluoridation offers the greatest hope for preventing caries because of its easy application for large numbers of people and its relatively low cost.

The manual was written for a dental audience but would be of interest to water works personnel who wish to learn something about the dental profession's thinking and approach to the subject. The brochure is technical, complete and well documented.

American Standard Code for Pressure Piping—ASA B31.1–1951. *American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N.Y. (1951) $3.50*

This revision of the 1942 code contains data on power piping systems and piping for gas and air, oil, heating and refrigeration. Tables of allowable stresses and information on supports and braces, welding, and materials specifications are included. Also included as a separately printed supplement is Section IX of the A.S.M.E. Boiler Construction Code, "Standard Qualification for Welding Procedure and Welding Operator."

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The Reading Meter

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Public Ground-Water Supplies in Illinois. *Ross Hanson, ed. Bul. 40, Illinois State Water Survey Div., Urbana, Ill. (1950) $8.00*

Completion of Bul. 40 revises and supplements earlier bulletins—published in 1925, 1938 and 1940—on Illinois supplies. This one, prepared in loose-leaf form, contains descriptions of water wells in 501 incorporated towns, 18 unincorporated communities, 10 state institutions and 6 state parks. When available, logs, chemical analyses and production data are given. In all, 1,213 wells are covered, located in all but the 16 counties of the state which do not use ground water.

Since the fresh water resources of a state are one of its greatest assets it is refreshing to know that at least one state is willing to finance the study and make available to its people the fundamental data on its ground water resources. This information is important to towns, industry, commerce and agriculture. Illinois and, more particularly, the State Water Survey Division, are to be congratulated on a job well done.

Section Meeting Reports

Kansas Section: The Kansas Section held its sixth annual meeting jointly with the Kansas Sewage Works Assn. at the Lamer Hotel in Hays on April 11–13. Of the total registration of 186, 121 were superintendents and operators and 65 were representatives of manufacturers, engineers and contractors.

On Wednesday afternoon Harry H. Connell, chief engineer for Wilson & Co., presented the paper "Supply Problems of Municipal Water Utilities in Kansas," prepared by Murray A. Wilson. This paper was well received here as it was when first offered at the November 1950 meeting of the Kansas Assn. of Municipal Utilities.

An interesting and informative panel discussion on water well construction and maintenance took place under the leadership of Ray E. Lawrence of Black and Veatch, consultants of Kansas City, Mo. Lawrence discussed the investigation of water productivity with new electrical tools, improvement of drilling techniques, improving yield by use of chemicals and maintenance of sanitary conditions at wells. E. J. Jungmann of the Jungmann Drilling Co., Topeka, and Darwin R. Soder of the Layne-Western Co., Wichita, members of the panel, discussed various methods of well construction and well repair, including the removal of broken screens and the

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repair to leaks in well casing. Late in the afternoon the water works group joined the sewage works operators on an inspection trip to the well managed Hays Sewage Plant.

On Thursday morning the entire convention group was warmly welcomed to the hospitality of the city of Hays by City Manager Bernard J. Brungardt. Chairman Al W. Rumsey made an appreciative response, after which A.W.W.A. Vice-President (and President-Elect) A. E. Berry outlined briefly the work of the national organization and emphasized the duties of the sections.

Harry A. Faber, research chemist of the Chlorine Institute, gave a brief history of the use of chlorine as a water sterilizing agent. He also pointed out that chlorination on a scientific basis requires recognition of purpose, understanding of principle, proper practice and control of operation. Slides were used for emphasis. "Chlorinating Practices and Installations in Kansas" were shown in a unique 8-mm. film prepared by L. H. Peterson and Joe Gyulay Jr. of the Wallace & Tiernan Sales Corp., Kansas City, Mo. This film showed chlorine installations and personnel in twenty Kansas cities: Topeka, Lawrence, St. Marys, Junction City, Enterprise, Salina,

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Hays, Clay Center, Beloit, Kansas City (Kan.), Goodland, Wichita, Iola, Fort Scott, Moline, Grenola, Otis, Hugoton, Manhattan and Chanute.

First on the program Thursday afternoon was an interesting discussion of various electrical equipment controls for special problems encountered in water and sewage plants, presented by Maynard DeNeui, Black & Veatch, Kansas City, Mo. Thomas F. Wolfe, director of the Cast Iron Pipe Research Assn., presented a paper on "Standardized Mechanical Joint Cast-Iron Pipe."

Emphasis was placed on keeping and studying accurate maintenance records, in order to receive maximum operating benefits from existing settling tanks, by William N. Konrad, Chain Belt Company, Milwaukee. Charles B. Elliott, water superintendent from Beatrice, Neb., in a short talk gave tips for improving public relations. W. H. Dominick, Wichita Meter Supply & Repair Co., and A. P. Flynn, Wichita Water Co., conducted a lively round table discussion on proper methods of handling water meters in the shop and on the job. Meter repairs procedure, determination of proper meter sizes by the use of recording register and methods of setting meters in service, were all actively discussed. There were many comments and questions from the floor. Morton C. Cunningham, president of Kansas State College at Hays, gave a challenging address at the annual banquet, held Thursday evening at Jefferson Grade School. Those who were there are not likely to forget the "Chord Busters," an able local male quartet. F. A. Russell, Fuller awardee of 1950, presented that award this year to Robert H. Hess, vice chairman of the section.

At the opening session Friday morning, April 13th, Dwight F. Metzler, chief engineer and director of the Div. of Sanitation, State Board of Health, Lawrence, discussed the progress of water treatment, ending with the status of fluoridation for public water supplies, which can now be approved and recommended. He mentioned the various fluorine compounds which are available, and suggested methods of application. Warren G. Paramore,

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executive assistant state director of civil defense, gave an informative talk on the subject of civilian defense as it applies to water properties. A. E. Berry concluded the program with a discussion on "Maintenance of Raw Water Quality Standards."

Following the well attended annual business meeting, an inspection trip to the water treatment plant at Hays, now under construction, was made by many of the visitors.

H. W. Badley
Secretary-Treasurer

Nebraska Section: The annual meeting of the Nebraska Section was held in Lincoln on April 19–20. As has been the custom during the section's brief existence, the technical and nontechnical sessions were conducted jointly with the Utilities Section of the League of Nebraska Municipalities and were followed by the annual business meeting of the A.W.W.A. section. Total joint registration for the conference exceeded 140 individuals representing every region of the state.

Technical presentation and panels on subjects of vital current interest ranged from complete discussions of fluoridation regulations and equipment to an excellent panel discussion of mutual aid in emergencies.

The section was especially honored and pleased to have the opportunity to hear and to meet Raymond J. Faust, new executive assistant secretary of A.W.W.A. Though his stay was brief, his quiet, winning manner established him permanently with the Nebraska Section.

The nontechnical highlight of the meeting was clearly the motion picture "High Horizons" perfectly photographed in color and narrated by William Ferguson, editor of "This Curious World." The picture contained many excellent actual photographs of wildlife in the mountains of Colorado with especial emphasis given to the birdlife of that region. The film was presented at the evening banquet which was attended by wives and friends

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as well as the members. The ladies were vociferous in their approval of the picture.

Less than four years old, the Nebraska Section is working diligently toward maturity. Progress is shown in recent actions by the section, which is beginning to operate as a closely knit organization whose primary function is to promote the improvement of public water uses and municipal water quality and services throughout the state of Nebraska.

E. Bruce Meier
Secretary-Treasurer

Montana Section: The 26th annual meeting of the Montana Section was held at the Placer Hotel, Helena, on April 20 and 21, 1951, with 87 members and guests registered.

On Friday morning the meeting was called to order by Harry McCann, chairman. The address of welcome was given by Mayor J. R. Kaiserman of the host city, and the response was given by Joseph Schmit. The chairman made his annual address to the section, and the reports of the national director, secretary-treasurer and the committees were received.

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A round-table discussion led by H. E. Henderson opened the technical sessions. S. R. Young of Harding brought up the question of controlling tastes and odors in water supplies, followed by A. L. Johnson of Kalispell, who led a discussion on copper pipe fittings. John B. Hazen of Butte then discussed water works tools and equipment, Rodney Preator of Helena discussed records and water works practice, and F. F. Palmer of Forsyth discussed methods of charging sewer usage along with the water bill. After each of the discussions, the meeting was open to the members to offer their comments and relate their experiences.

A field trip was made in the afternoon to the Canyon Ferry Dam, located approximately 25 miles northeast of Helena. William Price of the Bureau of Reclamation acted as guide and explained the construction features to the members of the section.

The opening paper on Saturday, in the opinion of most of the members, was the highlight of the meeting. Irvin G. Krick, of the Water Resources Development Corp., Denver, gave a very interesting discussion of "Rain Increase Projects" by artificial seeding of clouds chemically, causing them to precipitate their moisture. The discussion was illustrated with charts and slides to show the results of various projects in operation throughout the western United States.

On Saturday afternoon, the session was opened with an address on "Fluoridation of Public Water Supplies," with F. I. Livingston, director of the Dental Division of the Board of Health, discussing the dental aspects of fluoridation, and A. W. Clarkson discussing the new state fluoridation regulations and the procedure towns and cities must follow to obtain permission to fluoridate their water supplies. R. J. Faust, A.W.W.A. executive assistant secretary, discussed critical materials and priorities and explained what items used by water works men are controlled and what methods should be used for procuring the necessary orders to obtain these materials.

The final address of the meeting, on "Frost Penetration in Montana," was by John Hall, who observed that the type and color of the soil have a bearing on the depth to which the frost penetrates. He recommended that in northern climates, regardless of the character of the soil, water pipes should be buried to a minimum depth of 6½ ft.

The formal meeting closed with the business session, election of officers and reports of committees.

The meeting was brought to a close Saturday evening with a dinner-dance during which the Fuller Award was given to James Robert Cortese, and 25-Year Membership pins were awarded to Joseph Schmit of Lewistown and H. S. Thane of Hamilton.

A. W. CLARKSON
Secretary-Treasurer

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Directory of Professional Services—pp. 25–29

Index of Advertisers' Products

A complete Buyers' Guide to all water works products and services offered by A.W.W.A. Associate Members appears in the 1950 Membership Directory.

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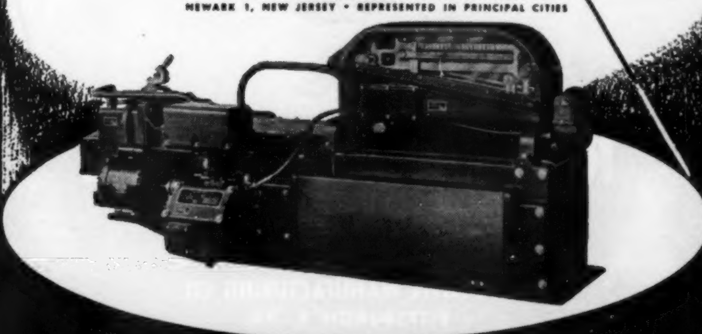

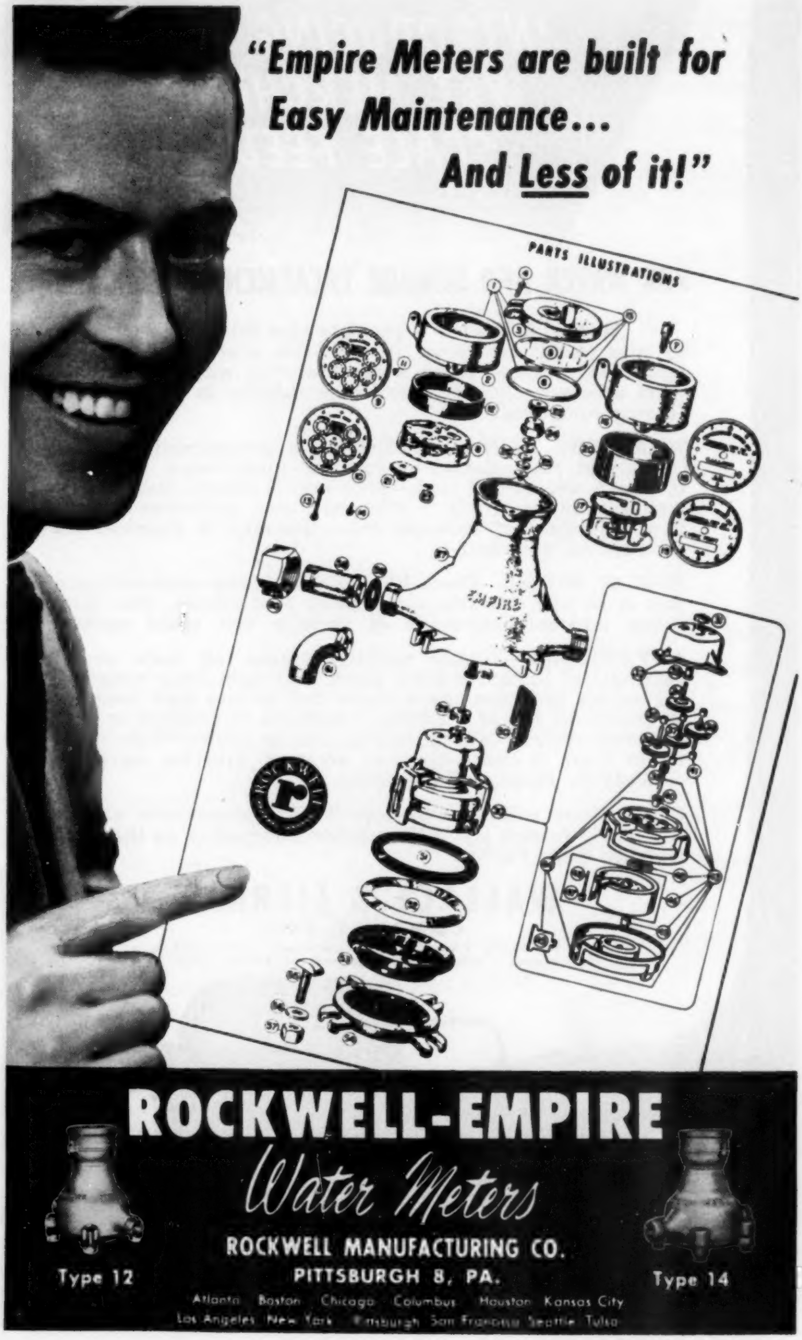
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